



BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email [info.bmjopen@bmj.com](mailto:info.bmjopen@bmj.com)

# BMJ Open

## Is there a Knowledge Translation Theory, Model or Framework Suitable for Health Technology Reassessment? Results from an International Survey

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-042251
Article Type:	Original research
Date Submitted by the Author:	29-Jun-2020
Complete List of Authors:	Esmail, Rosmin; University of Calgary Cumming School of Medicine, Community Health Sciences; Alberta Health Services, Hanson, Heather; University of Calgary Cumming School of Medicine; Alberta Health Services, Holroyd-Leduc, Jayna; University of Calgary Cumming School of Medicine; Alberta Health Services, Niven, Daniel; University of Calgary Cumming School of Medicine; Alberta Health Services, Clement, Fiona; University of Calgary Cumming School of Medicine; O'Brien Institute for Public Health
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

**Title:**

Is there a Knowledge Translation Theory, Model or Framework Suitable for  
Health Technology Reassessment? Results from an International Survey

**Author list:**

Rosmin Esmail, BSc, MSc, CHE<sup>1,2,3,4</sup>; rosmin.esmail@ucalgary.ca

Heather M. Hanson, PhD<sup>1,2</sup>; hmhanson@ucalgary.ca

Jayna Holroyd-Leduc, MD, FRCPC<sup>1,2,3,4,5</sup>; jayna.holroyd-leduc@ahs.ca

Daniel J. Niven, MD, MSc, PhD, FRCPC<sup>1,2,3,6</sup>; daniel.niven@ahs.ca

Fiona M. Clement, PhD<sup>1,3</sup>; fclement@ucalgary.ca

1. Department of Community Health Sciences, Cumming School of Medicine, University of Calgary
2. Alberta Health Services, Calgary, Alberta
3. O'Brien Institute for Public Health, University of Calgary, Calgary, Alberta
4. Department of Medicine, Cumming School of Medicine, University of Calgary
5. Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta
6. Department of Critical Care Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta

**Corresponding Author:**

Dr. Fiona M. Clement

3D14A Teaching and Wellness Building

3280 Hospital Drive NW

Calgary, Alberta, T2N 4Z6

Telephone number: 403-210-9373

Email: fclement@ucalgary.ca

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Word count: 3964

Figures: 3 (1 box and 2 figures)

Tables: 2

Supplementary files: 3

Supplementary file 1: Full Survey

Supplementary file 2: Operational Definition of Criteria

Supplementary file 3: List of Excluded KT Theories, Models, and Frameworks and Reason of Exclusion

For peer review only

**Abstract:**

**Objective:** Health Technology Reassessment (HTR) is an emerging field focused on managing a technology throughout its lifecycle for optimal use. The process results in four recommendations: increase use, decrease use, no change, or complete withdrawal of the technology. However, implementation of these recommendations has been challenging. This paper explores knowledge translation (KT) theories, models and frameworks (TMFs) and their suitability for implementation of HTR recommendations.

**Design:** Cross-sectional Survey

**Participants:** Purposeful sampling of international KT and HTR experts was conducted between January and March 2019.

**Methods:** Sixteen full-spectrum KT TMFs were rated by the experts as “yes”, “partially yes”, or “no” on six criteria: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability. Consensus was determined as a rating of  $\geq 70\%$  responding “yes”. Descriptive statistics and manifest content analysis was conducted on open-ended comments.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Results:** Eleven HTR and 11 KT experts from Canada, US, UK, Australia, Germany, Spain, Italy and Sweden participated. Of the 16 KT TMFs, none received  $\geq 70\%$  rating . When ratings of “yes” and “partially yes” were combined, the Consolidated Framework for Implementation Research (CFIR) was considered the most suitable KT TMF by both KT and HTR experts (86%). One additional KT TMF was selected by KT experts: Knowledge to Action framework. HTR experts selected two additional KT TMFs: co-KT framework and Plan Do Study Act cycle. Experts identified three key characteristics of a KT TMF that may be important to consider: practicality, guidance on implementation, and KT TMF adaptability.

**Conclusions:** Despite not reaching an overall  $\geq 70\%$  level of consensus, experts identified four KT TMFs suitable for HTR. Users may apply these KT TMFs in the implementation of HTR recommendations. In addition, KT TMFs characteristics relevant to the field of HTR need to be explored further.

**Key words:** Health Technology Reassessment, Disinvestment, De-adoption, De-implementation, Theories, Models and Frameworks, Knowledge Translation, Implementation Science.

**Article Summary**

**Strengths and Limitations of Study**

- This was the first study to survey HTR and KT experts on KT TMFs that could be suitable for HTR.
- Through purposeful sampling, an international survey was conducted and experts were asked to rate KT TMFs as “yes”, “partially yes”, or “no” on six criteria: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability.
- Descriptive statistics on ratings and manifest content analysis was conducted on open-ended comments.
- The sample size of international KT and HTR experts was small to generate  $\geq 70\%$  level of consensus on which KT TMFs may be suitable for HTR.



**Background**

Health Technology Reassessment (HTR) is the systematic process of evaluating technologies that are currently in the system to ensure that they are being used optimally (1).

Recommendations from the HTR process can result in the increase use, decrease use, no change, or complete withdrawal of the technology (2). However, implementation of these recommendations has been challenging (2). It has been argued that the field of knowledge translation (KT) could play a role in the implementation process for HTR recommendations (3). KT has been described as “a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of [populations], provide more effective health services and products, and strengthen the healthcare system” (4). KT can be seen as complimentary to the HTR process, but there has been a paucity of research in this area (3). Moreover, there is a gap in our understanding of which KT theories, models, or frameworks (KT TMFs hereafter) would be best suited for the translation of HTR recommendations (3).

Reviews have reported from 51 to 159 KT TMFs depending on how they are identified and considered (5-8). KT TMFs have been used in different contexts, settings, and populations (5-8). Moreover, there has been some use of the KT interventions, strategies, and TMFs to decrease or remove low value care (9, 10). These KT TMFs have been used to help identify determinants, barriers and enablers to behaviour change related to HTR (11, 12). However, the use of these KT TMFs has not been applied consistently to the development of KT interventions or the field

of HTR (3, 13). There are also no recommendations about which KT TMFs could be used. Through an international survey of KT and HTR experts, this study aims to provide an understanding of which KT TMFs could be appropriate for the HTR process and implementation of its recommendations.

## Methods

This study used three approaches to the selection of KT TMFs for HTR: identification of suitable KT TMFs, consensus on the list of KT TMFs through a modified Delphi process, and selection of potentially suitable KT TMFs through a survey of international KT and HTR experts.

Ethics approval was obtained from the University of Calgary's Conjoint Health Research Ethics Board [REB#17-0932].

### Identification of Suitable KT TMFs

Only full-spectrum KT TMFs were included. "Full-spectrum" includes all four KT phases: planning/design, implementation, evaluation, and sustainability/scalability (8). These four KT phases are critical to the KT process and are thought to be necessary for the HTR process and implementation of its recommendations (3). A recent scoping review provided a preliminary list of 26 full-spectrum KT TMFs within cancer and chronic disease management contexts (8). A

recent update resulted in 36 full-spectrum KT TMFs identified (14). Eighteen were process models, eight were classic theories, three were determinant frameworks, three were evaluation frameworks, and four fit more than one approach category (14). This list of 36 full-spectrum KT TMFs provided the initial list of KT TMFs to assess for use when implementing HTR recommendations.

**Modified Delphi Process**

A three-round modified Delphi process was undertaken (15-17). The Delphi process is iterative and used to determine expert group consensus where there is a lack of evidence and expert opinion is important (18). The expert committee was composed of two HTR and three KT experts. The first and second rounds involved independent review of each KT TMF to determine which would be suitable for HTR. Each member rated the KT TMF as “yes” , “potentially yes”, or “no” for HTR suitability. Consensus to keep the KT TMF was defined as 100% of the members rating the KT TMF as “yes” and/or “potentially yes”. Consensus to eliminate the KT TMF was defined as 100% of the members rating the KT TMF as ‘no’ and/or ‘potentially no’. Any KT TMFs that did not reach consensus were discussed in subsequent rounds. The third round entailed a two-hour face-to-face meeting held in October 2018. Prior to the discussion at this meeting, committee members agreed on ground rules, principles, and criteria for selection of KT TMFs for HTR suitability (Table 1). Committee members deliberated on the remaining KT TMFs until consensus was reached. Verbal consent to participate was obtained prior and the meeting was recorded.

## International Expert Survey

### *Selection of Experts to Review KT TMFs for HTR*

HTR and KT experts were selected through purposive and snowball sampling. Names were initially derived through the KT Canada website, Health Technology Assessment international (HTAi) Disinvestment Interest group, authors of relevant publications, and in consultation with other experts. A list of HTR and KT international experts was generated by country including Canada, US, UK, Australia, and European countries (Germany, Italy, Sweden, Spain). Experts were contacted via email to participate in the study. They were sent an email, invitation letter, and information sheet. If they agreed to participate, they were sent a consent form, a survey with the list of KT TMFs identified by the Delphi process to rate (Supplementary file 1), and recent article on the topic as background information (3). If they were unable to participate, the next expert name on the list was contacted. This was done to ensure that there were at least two HTR and two KT experts from each of Canada, US, UK, Australia and four HTR and four KT experts from other European countries for a target sample size of 24. Experts contacted could also suggest additional names of experts to be surveyed through snowball sampling. These names were added to the list of experts and contacted, if required, to reach a representative sample.

**Survey Development**

The Enhancing The Quality and Transparency of Health Research (EQUATOR) good practice in the conduct and reporting of survey research guidelines were followed for the development of the survey (19). The survey included the list of KT TMFs, a description of each KT TMF, followed by a link to the paper that described the KT TMF, if one was available. Specific criteria used previously to select KT TMFs were used to rate each KT TMF (20). These included: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability. Each criteria was operationally defined and reviewed by FC and HMH (Supplementary file 2). There was also a section for open-ended comments. The survey was developed in Excel and pilot tested by four participants to ensure flow and functionality.

**Survey Administration**

The survey was administered via email to the experts starting in January 2019. Based on the criteria, each KT TMF was rated by each expert as “yes”, “partially yes” or “no” and additional comments could be provided. Experts were also asked to suggest additional full-spectrum KT TMFs that could be suitable for HTR and recommend other experts that could be contacted for the study. Consensus was determined as  $\geq 70\%$  experts selected “yes” for the particular KT TMF. The principles and criteria described in Table 1 were also shared with the international experts for information purposes. Experts were asked to return the survey within two weeks. Two additional reminders were sent. If surveys were not returned, then another expert on the list

was contacted to participate in the study. The survey was sent out to experts until March 31, 2019 to ensure that at least two HTR and two KT experts had agreed to complete the survey from the identified countries.

## Data Analysis

### *Modified Delphi Process*

After rounds 1 and 2 of the modified Delphi process, data were analyzed descriptively by tabulating the “yes”, “potentially yes”, and “no” responses for HTR suitability for each KT TMF reviewed by the expert committee members.

### *Survey Data*

Survey data were analyzed descriptively by tabulating the “yes”, “partially yes”, and “no” responses for HTR suitability for each KT TMF and by HTR and KT expert sub-groups. KT TMF familiarity and missing data were also descriptively summarized.

Data from the open-ended comments section of the survey provided by the HTR and KT experts was analyzed using content analysis (21). As these data were limited in volume, content analysis was undertaken to provide a starting point in determining preliminary factors that may be important to consider for a KT TMF for HTR.

Initially, all comments from each expert were entered into Excel and categorized by KT TMF. These were read and reread to get familiarized with the data. Next, for each KT TMF, each comment was organized by response to HTR suitability as “yes”, “partially yes”, “no”, and unfamiliar with the KT TMF. This categorization provided an understanding of what comments may or may not be important to consider for HTR suitability. Open coding and constant comparison were applied inductively to all the comments. A preliminary list of codes, sub-codes, and operational definitions were developed manually through independent review of the comments from three KT TMFs (Consolidated Framework for Implementation Research (CFIR), Stages of Research Evaluation, and Knowledge to Action (KTA) framework) by RE and HMH. A final taxonomy consisting of codes, sub-codes, operational definitions, and exemplar quotes was applied manually to the comments for the remaining KT TMFs by RE (Box 1). Manifest content analysis, defined as the development of categories as opposed to latent content analysis (defined as the development of themes), was determined to be best suited given the nature of the open-ended comments (21). Therefore, categories were created, grouping codes under higher order headings, and formulating a general description of these categories. In addition, the frequency of comments for each code in each category was also tabulated by HTR and KT expert to determine the top categories/codes. The most prominent codes and interpretation of the data were then determined through the frequency counts, discussion and consensus among FC and HMH.

**Patient and public involvement**

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

## Results

### Modified Delphi Process

The results of the modified Delphi process are presented in Table 2. The third round resulted in the selection of 16 full-spectrum KT TMFs. There were 12 process models, two frameworks, one classic theory, and one KT TMF that fit two categories (model and framework). Twenty KT TMFs were excluded. Fourteen were too vague and not descriptive enough, two were considered ‘passive’ and not ‘active’ KT TMFs to make change happen, two were not pragmatic, and two were too specific to a given context (i.e. guideline adaptation and disability research) (Supplementary file 3).

### International Expert Survey

Forty-eight KT experts and 31 HTR experts were invited to participate via email. A total of 22 experts (11 KT and 11 HTR) completed the survey. Experts were from Canada (4), US (5), UK (4), Australia (4), Germany (2), Spain (1), Italy (1), and Sweden (1). Fifty-nine percent were women, and all had graduate-level education (Masters or PhD).

Overall, of the 16 KT TMFs none received a “yes” rating for HTR suitability by  $\geq 70\%$  of the experts. The top three most highly rated KT TMFs were CFIR (22), KTA (23) and the Plan-Do-



Study-Act (PDSA) cycle (24). Thirty-eight percent of the experts rated CFIR as “yes”, followed by 27% each for the KTA framework and the PDSA cycle (24). The least rated KT TMFs by the experts were the KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (25), the Stages of Research Evaluation (26), the Staged Model of Innovation Development and Diffusion of Health Promotion Programs (27) that all received 0% ratings for “yes” by the experts (Figure 1). Combination of the “yes” or ‘partially yes’ ratings found that 86% (19/22) of the experts selected CFIR as the top rated KT TMF for HTR suitability (22).

**Stratified analysis by KT and HTR Expertise**

KT experts favored KTA (82%, 9/11) as another KT TMF that would be suitable for HTR (23) in addition to CFIR (91%, 10/11). The HTR experts favored the Co-KT Framework (72%, 8/11) (28) and the PDSA cycle (72%, 8/11) (24) in addition to CFIR (82%, 9/11).

**Content Analysis**

Forty-nine percent of the comments provided by both KT and HTR experts were related to the TMF characteristics category, followed by the TMF attributes category (19%). Implementation and user categories both had 13% each (Figure 2).

Overall, the top code was pragmatic under the TMF characteristics category (14%) defined as the KT TMF not being theoretical but practical and application of the TMF outside of research or

academic settings. This was followed by implementation (13%), defined as the KT TMF provides operation detail on how to ‘do’ the implementation to achieve the HTR outputs. This also included exploring determinants, their inter-relationships, and the development of interventions or strategies based on these determinants. The third top code was HTR suitability under the TMF attributes category (8%), defined as a ‘strong fit’ to HTR and its determinants. It also included the ability to adapt the KT TMF and tailor it to micro (individual), meso (organizational) and macro (policy) levels (3).

More KT experts than HTR experts commented on pragmatic as an important characteristic for a KT TMF (56% versus 44%). There were both positive and negative comments related to pragmatic for a KT TMF that would make it suitable for HTR. For example, one KT expert who said “yes” to HTR suitability for the PDSA cycle noted the following positive affect:

“A basic, simple but still very useful approach” [009].

In contrast, in reference to the Stages of Research Evaluation, one HTR expert who said ‘no’ to HTR suitability stated the following negative affect:

“This is also difficult to be implemented in reality as it is far from explaining the characteristics of the healthcare systems and professional interactions” [017].

More KT experts than HTR experts provided comments related to implementation (78% versus 22%). There were both positive and negative affects of comments related to implementation for a KT TMF that would make it suitable for HTR. One KT expert who said “yes” to HTR suitability for the Quality Implementation framework stated the following positive affect:

“I’m not familiar with specifics about this framework; it certainly covers the full-spectrum of considerations for implementing new interventions; could be adapted for de-adoption/implementation “[005].

On the contrary, another KT expert who said ‘no’ to HTR suitability with respect to Diffusion of Innovation theory stated the following negative affect:

“I think (as it is a general theory rather than an implementation framework/model) that it lacks sufficient guidance on how to implement/de-implement” [007].

More KT experts provided comments to HTR suitability than HTR experts (60% versus 40%). There were both positive and negative affects of comments related to HTR suitability for a KT TMF. One HTR expert who said partially “yes” to HTR suitability for CFIR stated the following positive affect:

“A lot of constructs have been included in CFIR, so in each case, it would probably require selection of the specific ones relevant for the HTR example” [021].

Whereas another KT expert who said ‘no’ to HTR suitability for the CollaboraKTion framework stated:

“Depends on focus of work-this emphasizes need for community to decide on action whereas if you had a particular output in mind to implement/de-implement this might not be the best fit” [001].

However, HTR experts commented more on the ability to tailor the KT TMF to micro, meso, macro levels than KT experts (90% versus 10%).

**Discussion**

## Key Findings

The focus of this study was to determine KT TMFs that could be suitable for implementation of HTR recommendations. Three key findings emerged: 1)  $\geq 70\%$  consensus (rated as “yes” by the experts) was not reached by the international KT and HTR experts on any of the full-spectrum KT TMFs; however when ratings of “yes” and “partially yes” were combined, CFIR was considered the most suitable KT TMF by both KT and HTR experts; 2) KT experts identified one additional KT TMF: KTA framework, whereas HTR experts identified two additional KT TMFs: co-KT framework and PDSA cycle as potentially suitable for the implementation of HTR recommendations; and 3) Overall, experts commented on three key characteristics of a KT TMF that may be important to consider: practicality, guidance on how to implement and adaptability of the KT TMF to HTR.

## Strengths

This study utilized a modified Delphi process and survey to illicit input from internal and international KT and HTR experts. Although, experts may not have sufficient knowledge of all the KT TMFs, this was the first study that attempted to garner the opinions of experts in both fields of KT and HTR. The field of KT and its application to HTR has been proposed as a mechanism to advance the implementation of HTR recommendations into practice (3). The selection of one determinant framework (CFIR), and three process models (KTA framework, co-

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

KT framework, and the PDSA cycle) provides a starting point of potential KT TMFs that could be used with HTR. However, as  $\geq 70\%$  consensus was not reached by the experts, these findings need to be considered as preliminary.

**Limitations**

The Delphi technique has been criticized for lack of guidelines on the determination of the size of the expert panel, lack of anonymity, what is meant by ‘expert’ opinion, and determination on the level of consensus (29). The sample size of five for the internal committee may have been too small to review and select KT TMFs from the list of 36 full-spectrum KT TMFs. The 100% consensus level may have been too high. There may also have been pressures of conformity at the face-to-face meeting. However, there was a wide-range of expertise within the internal committee including two physicians, health economist, epidemiologist, and social scientist all with backgrounds in HTR, KT or both. The use of a facilitator and establishment of ground rules, and principles upfront were important considerations to address pressures of conformity. Although purposeful sampling was used for the survey, the sample size of international KT and HTR experts was small which may have reduced the ability to generate consensus. Both the KT and HTR communities are relatively new and small. Therefore, there is a limit to the pool of experts one can select from. However, a wide net was cast to recruit experts and efforts were also made to ensure a representative sample from different jurisdictions and depth and breadth of knowledge in both KT and HTR. Lastly, the selection of 70% consensus was arbitrary and determined a priori to survey administration. This level of agreement has been considered appropriate in previous Delphi studies (30), but there is no acceptable level of consensus (29).

## Implications of Findings

Among the list of 16 full-spectrum KT TMFs identified through a modified Delphi process, the international experts were unable to determine a clear KT TMF for HTR. Lack of familiarity with the KT TMFs could be one reason. Specifically, experts were not familiar enough with four of the 16 KT TMFs to rate them for HTR suitability. Over recent years, there has been a flurry of KT TMFs developed (8). This proliferation of KT TMFs makes it challenging for experts to keep abreast of them all. Moreover, there has been criticism of the development of KT TMFs without adequate testing, validation and research (31). Experts within the KT field may lean towards those KT TMFs that they are most familiar with (8).

Another reason experts were challenged to select a KT TMF could have been due to the lack of understanding of the HTR process. KT experts in particular, may have found it difficult to review the KT TMFs and then apply them to HTR, as they may not be familiar enough with the HTR process itself. HTR is a relatively new field and has been confused with terms such as 'disinvestment' and 'de-adoption', which are considered outcomes of the HTR process rather than the process itself (2). In addition, the field of HTR is under-developed and concepts have yet to be agreed upon (3). An information sheet and background paper with a description of the fields of KT and HTR was provided to the experts prior to the survey. However, these materials may not have been reviewed in advance or been a sufficient knowledge resource.

CFIR was the only KT TMF selected by both HTR and KT experts as a potential KT TMF that could be used for HTR. CFIR has been used widely and is a well-operationalized, multi-level implementation determinant framework derived from theory (32, 33). The application of CFIR and its constructs may enable users to assess facilitators and barriers to the implementation of HTR recommendations, particularly when HTR recommendations result in decrease use or removal of the technology. The assessment of facilitators and barriers has been noted as an important step within the de-adoption process of low value care (3, 34). However, studies that apply CFIR to HTR projects are required to provide further understanding of its application.

The KTA framework was primarily selected as suitable for HTR by KT experts. Its selection could be due to its wide-spread use in the KT field (35, 36). In fact, one adaptation of the KTA framework has been the Synthesis Framework for Facilitating De-adoption (34). This framework has been proposed as one that could be used for potential HTR projects (3). However, it has yet to be applied in practice for HTR. Nonetheless, the KTA framework's ability to be adaptable may be another factor as to its selection primarily by KT experts.

The co-KT framework (28) and PDSA cycle (24) were primarily selected for HTR suitability by HTR experts. Both are process models (14). The co-KT framework is a linear process and may be considered simplistic to apply. The PDSA cycle has been used extensively in quality improvement as a model for change (37). It is a simple and pragmatic model to use and is adaptable within other models (38). However, it is not without its limitations (37). Subsequently, selection of these KT TMFs by HTR experts may be due their ease of use.

## Implications for Future Research

Although not the key focus of this study, three key characteristics: practicality, guidance on how to implement; and adaptability of the KT TMF to HTR were identified from the open-ended comments. Characteristics that may be considered as important in a KT TMF for HTR use need to be investigated further. Moreover, future research on identifying these characteristics through expert interviews is needed to better understand which would influence and demonstrate an important role within the process of HTR.

Recently, there has also been a proliferation of disinvestment frameworks or frameworks to address overuse (13, 39, 40). Some are based on KT and Implementation Science principles (13). The focus of these frameworks has been on removing or reducing low value care from practice. The application of these frameworks is still in its infancy. Although, the list of full-spectrum KT TMFs that were examined in this study did not consider these disinvestment frameworks, there may be merit in doing so. In particular, the use of these frameworks for the HTR outputs of decrease use or complete removal of a technology.

## Conclusion



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

This study provided insights into which KT TMFs may be suitable for HTR. Despite not attaining  $\geq 70\%$  consensus on the KT TMFs, experts selected four KT TMFs that could be used within the context of HTR. Familiarity, adaptability and ease of use may be some of the reasons that led to their selection. Moreover, characteristics of practicality, how to implement HTR recommendations, and adaptability of the KT TMF to HTR need to be interrogated to determine if they are important in a KT TMF for HTR. The process of HTR could vastly benefit from the field of KT and its application of KT TMFs in implementation of its recommendations. A better understanding and awareness of the application of KT to the field of HTR will provide much needed guidance and advancement in this area.

**Competing Interests:** None

**Funding:** Rosmin Esmail is funded through an Alberta Innovates – Health Solutions Graduate Studentship Award. The funding body did not participate in the design of the study and collection, analysis, and interpretation of data or writing of the manuscript.

**Contributors:** Rosmin Esmail conducted the study, collected and analyzed the data. Rosmin Esmail, Fiona Clement and Heather Hanson drafted the manuscript. All the authors contributed to the study conception and design, data interpretation, were involved in revising the manuscript for important intellectual content. All authors read and approved the final manuscript.

**Acknowledgments:** We would like to thank all the individuals that participated in this study for their support and contributions to this work.

References:

1. Noseworthy T, Clement FM. Health Technology Reassessment: Scope, Methodology, & Language. *Int J Technol Assess Health Care*. 2012;28(3):201-2.

2. Soril L, MacKean G, Noseworthy TM, Leggett LE, Clement FM. Achieving Optimal Technology Use: A proposed model for health technology reassessment. *Sage Open Medicine*. 2017;5:1-7.

3. Esmail R, Hanson H, Holyrody-Leduc J, Niven DJ, Clement F. Knowledge translation and health technology reassessment: identifying synergy. *BMC Health Serv Res*. 2018;18:674.

4. Canadian Institutes of Health Research. Knowledge Translation. 2017 [Available from: <http://www.cihr-irsc.gc.ca/e/29529.html>].

5. Lokker C, McKibbon KA, Colquhoun H, Hempel S. A scoping review of classification schemes of interventions to promote and integrate evidence into practice in healthcare. *Implement Sci*. 2015;10:27.

6. Milat AJ, Li B. Narrative review of frameworks for translating research evidence into policy and practice. *Public Health Res Pract*. 2017;27(1):1-13.

7. Tabak RG, Khoong EC, Chambers DA, Brownson RC. Bridging research and practice: models for dissemination and implementation research. *Am J Prev Med*. 2012;43(3):337-50.

8. Striffler L, Cardoso R, McGowan J, Cogo E, Nincic V, Khan PA, et al. Scoping review identifies number of knowledge translation theories, models and frameworks with limited use. *Journal of Clinical Epidemiology*. 2018;100:92-102.

9. Colla CH, Mainor AJ, Hargreaves C, Sequist T, Morden N. Interventions Aimed at Reducing Use of Low-Value Health Services: A Systematic Review. *Medical Care Research and Review*. 2017;74(5):507-50.

10. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci*. 2012;7(1):37.

11. French SD, Green SE, O'Connor DA, McKenzie JE, Francis JJ, Michie S, et al. Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implement Sci*. 2012;7(1):38.

12. Soril LJJ, Noseworthy TW, Stelfox HT, Zygun DA, Clement FM. Facilitators of and barriers to adopting a restrictive red blood cell transfusion practice: a population-based cross-sectional survey. *CMAJ open*. 2019;7(2):E252-E7.

13. Grimshaw JM, Patey AM, Kirkham KR, Hall A, Dowling SK, Rodondi N, et al. De-implementing wisely: developing the evidence base to reduce low-value care. *BMJ Quality & Safety*. 2020:bmjqs-2019-010060.

14. Esmail R, Hanson HM, Holroyd-Leduc J, Brown S, Striffler L, Straus SE, et al. A scoping review of full-spectrum knowledge translation theories, models, and frameworks. *Implement Sci*. 2020;15(1):11.

15. Dalkey NC. The Delphi Method: An experimental study of group opinion. RM-5888-PR TRCP, editor. Santa Monica 1969.

16. Dalkey NC, Helmer O. An experimental application of the Delphi method to the use of experts. *Manag Sci* 1963;9(3):458-67.

17. Hsu CC, Sanford BA. The Delphi Technique: Making Sense Of Consensus. *Practical Assessment Research & Evaluation*. 2007;12(10):2-8.

18. Meshkat B, Cowman S, Gethin G, Ryan K, Wiley M, Brick A, et al. Using an e-Delphi technique in achieving consensus across disciplines for developing best practice in day surgery in Ireland. *J Hosp Adm.* 2014;3(4):1-8.
19. Kelley K, Clark B, Brown V, Sitzia J. Good practice in the conduct and reporting of survey research. *Int J Qual Health Care.* 2003;15(3):261-6.
20. Birken SA, Powell BJ, Shea CM, Haines ER, Kirk MA, Leeman J, et al. Criteria for selecting implementation science theories and frameworks: results from an international survey. *Implement Sci.* 2017;12:124.
21. Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nurs Health Sci.* 2013;15(3):398-405.
22. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci.* 2009;4(1):50.
23. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, et al. Lost in knowledge translation: time for a map? *J Contin Educ Health Prof.* 2006;26(1):13-24.
24. Deming W. Plan-Do-Study-Act (PDSA) Cycles 1986 [Available from: <https://deming.org/explore/p-d-s-a>]
25. Nieva VF MR, Ridley N, et al. From Science to Service: A Framework for the Transfer of Patient Safety Research into Practice. . United States: In: Henriksen K, Battles JB, Marks ES, et al., editors. *Advances in Patient Safety: From Research to Implementation (Volume 2: Concepts and Methodology)*. Rockville (MD): Agency for Healthcare Research and Quality 2005 Feb.
26. Nutbeam D, Bauman AE. *Evaluation in a Nutshell: A Practical Guide to the Evaluation of Health Promotion Programs*: McGraw-Hill; 2006.
27. Oldenburg BF, Hardacker C, Ffrench ML. How does Research Contribute to Evidence-based Practice in Health Promotion? *Health Promot J Aust.* 1996;6(2):15-20.
28. Kitson A, Powell K, Hoon E, Newbury J, Wilson A, Beilby J. Knowledge translation within a population health study: how do you do it? *Implement Sci.* 2013;8(1):54.
29. The Delphi Technique. *The Delphi Technique in Nursing and Health Research.* p. 1-17.
30. Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, et al. Defining consensus: A systematic review recommends methodologic criteria for reporting of Delphi studies. *Journal of Clinical Epidemiology.* 2014;67(4):401-9.
31. Wensing M, Grol R. Knowledge translation in health: how implementation science could contribute more. *BMC Medicine.* 2019;17(1):88.
32. Birken SA, Powell BJ, Presseau J, Kirk MA, Lorencatto F, Gould NJ, et al. Combined use of the Consolidated Framework for Implementation Research (CFIR) and the Theoretical Domains Framework (TDF): a systematic review. *Implementation science : IS.* 2017;12(1):2.
33. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the Consolidated Framework for Implementation Research. *Implementation science : IS.* 2016;11:72-.

34. Niven DJ, Mrklas KJ, Holodinsky JK, Straus SE, Hemmelgarn BR, Jeffs LP, et al. Towards understanding the de-adoption of low-value clinical practices: a scoping review. BMC Medicine. 2015;13(1):255.

35. Field B, Booth A, Iltott I, Gerrish K. Using the Knowledge to Action Framework in practice: a citation analysis and systematic review. Implement Sci. 2014;9(1):172.

36. Esmail R, Hanson H, Holroyd-Leduc J, Brown S, Striffler L, Straus S, et al. A Scoping Review of Full-Spectrum Knowledge Translation Theories, Models and Frameworks - draft manuscript. 2020.

37. Reed JE, Card AJ. The problem with Plan-Do-Study-Act cycles. BMJ Quality & Safety. 2016;25(3):147-52.

38. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. BMJ Quality & Safety. 2014;23(4):290.

39. Norton WE, Chambers DA, Kramer BS. Conceptualizing De-Implementation in Cancer Care Delivery. Journal of Clinical Oncology. 2019;37(2):93-6.

40. Parchman ML, Henrikson NB, Blasi PR, Buist DS, Penfold R, Austin B, et al. Taking action on overuse: Creating the culture for change. Healthc (Amst). 2017;5(4):199-203.

**Table 1: List of Criteria Developed by Expert Committee Members for Round 3 of Modified Delphi Process**

Criteria
The final list of KT TMFs must have face validity (KT TMFs that are common and well-known should be included)
The KT TMFs must be active KT TMFs (passive KT TMFs were excluded)
The KT TMF must be feasible to apply to take something out of practice
The KT TMF was pragmatic (theoretical KT TMFs were excluded)
The KT TMF must be specific (vague or those that were not prescriptive were excluded)
The KT TMF could build on other KT TMFs but needed to be generic rather than for a specific context
The KT TMF is easily understood and practical
Any KT TMF that the committee was undecided on

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47

**Box 1: Taxonomy of Codes and Sub-codes for Comments**

Implementation	TMF Characteristics	TMF Attributes	User	Survey Logistics/General Comments
Codes in a KT TMF related to implementation of HTR	Codes related to elements or components in a KT TMF for HTR	Code that are considered foundational in a KT TMF for to HTR	Codes related to the use of TMFs for HTR from a user perspective	Codes related to the process of survey administration or extraneous
<ul style="list-style-type: none"><li>Implementation<ul style="list-style-type: none"><li>Development of intervention or strategies</li><li>Inter-related determinants</li></ul></li></ul>	<ul style="list-style-type: none"><li>Pragmatic real world application</li><li>Straightforward</li><li>Engagement of relevant (patient, public, clinician) stakeholders<ul style="list-style-type: none"><li>Synchronicity</li></ul></li><li>Lack specificity/insufficient details</li><li>Complexity</li><li>Prioritization of HTR</li><li>Resources such as economic, evidence, funding, local factors.<ul style="list-style-type: none"><li>Additional support</li></ul></li><li>Adaptation<ul style="list-style-type: none"><li>Additional TMFs</li></ul></li><li>Sustainability</li><li>Evaluation</li><li>Influential<ul style="list-style-type: none"><li>Originality (face validity)</li></ul></li></ul>	<ul style="list-style-type: none"><li>HTR Suitability</li><li>Consideration of alternatives</li><li>Ability to tailor or applicability micro/meso/macro levels</li><li>Centrality evidence</li><li>Contextual fit</li><li>Motivation<ul style="list-style-type: none"><li>Challenge of removing something (feasible to apply -take something out of practice)</li></ul></li><li>Values</li><li>Generalizability</li><li>Not a KT TMF</li></ul>	<ul style="list-style-type: none"><li>Familiarity</li><li>Access</li><li>Use by novices</li></ul>	<ul style="list-style-type: none"><li>Survey process/method oriented</li><li>Non-dated data</li></ul>

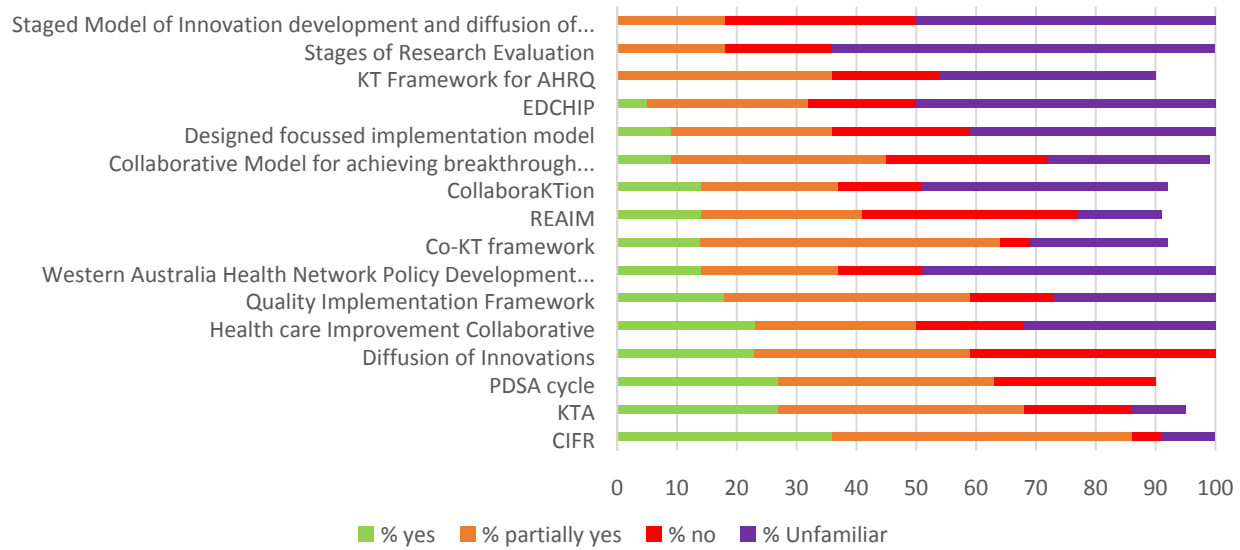
**Table 2: Summary Results of KT Theories, Models and Frameworks Included and Excluded from Rounds 1 to 3 of the Modified Delphi Process**

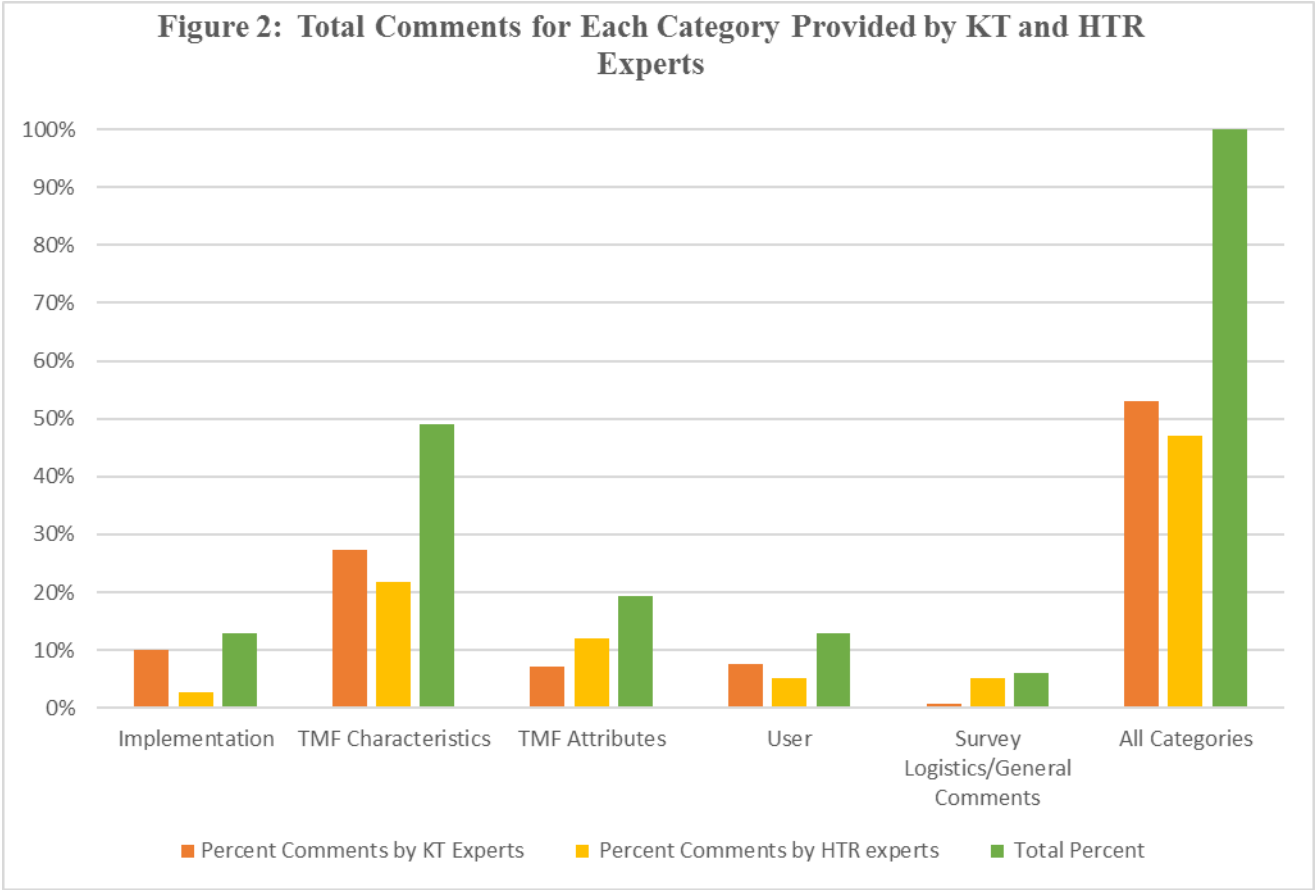
<b>Included in Round 1</b>	<b>Excluded in Round 1</b>
Consolidated Framework for Implementation Research (CFIR) (Damschroder, 2009)	A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)
Stages of research evaluation (Nutbeam, 2006)	Interorganizational Relations Theory (Steckler, 2002)
Knowledge-to-Action (KTA) (Graham, 2006)	Self-Regulation Theory (Baumeister, 2011)
Quality Implementation Framework (Meyers, 2012)	Social Cognitive Theory (SCT) (Bandura, 1991)
Western Australia (WA) Health Network Policy Development and Implementation Cycle (Briggs, 2012)	Social Ecology Model for Health Promotion (Stokols, 1992)
	Transtheoretical Model of Behaviour Change (Prochaska, 1997)
<b>Included in Round 2</b>	<b>Excluded in Round 2</b>
Collaborative model for achieving breakthrough improvement (Institute for Healthcare Improvement, 2003)	LEAN transformation process (Lean Enterprise, 2011)
<b>Included in Round 3</b>	<b>Excluded in Round 3</b>
Diffusion of Innovations (Rogers, 1983)	NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)
Healthcare Improvement Collaborative Model (Edward, 2017)	Community Connection model (Liddy, 2013)
Co-KT framework (Kitson, 2013)	Model for accelerating improvement (Associates in Process Improvement Langley, 2009)
Plan-do-study-act cycle (Deming, 1986)	Social marketing framework (National Excellence Collaborative, 2003)
A staged model of innovation development and diffusion of health promotion programs (Oldenburg, 1996)	Community-based Knowledge Translation framework (Campbell, 2010)
Evidence-driven community health improvement process (EDCHIP) (Layde, 2012)	Knowledge integration process (Glasgow, 2012)
RE-AIM (Glasgow, 1999)	Precaution Adoption Process model (Weinstein, 2008)
CollaboraKTion framework (Jenkins, 2016)	Social learning theory (Bandura, 1952)
KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (Nieva, 2005)	CAN-IMPLEMENT (Harrison, 2018)



Design focused implementation model (Ramaswamy, 2018)	The translational model of the Black Dog Institute (Werner-Seidler, 2016)
	PRECEDE-PROCEED (Green, 2005)
	Community to community mentoring model (Liddy, 2013)
	Stage theory of organization change (Butterfoss, 2008)
<b>Total Included=16</b>	<b>Total Excluded=20</b>

For peer review only

**Figure 1: HTR Suitability of KT Theories, Models, Frameworks (TMF) by all Experts**



**Instructions:**

Dear Expert, there are 16 full-spectrum KT theories, models and frameworks to review in column A. A brief description of each KT theory, model, framework is provided through a comment box (red triangle in corner of the cell) and a link to the paper, if available, in column B. For each full-spectrum Knowledge Translation (KT ) theory, model or framework please review each criteria in sheet #1 columns C to G and rate as yes, In sheet #1, based on your responses to columns C to G, please determine if that KT theory, model or framework is suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology) and indicate your response as yes, partially yes, or no using the drop box menu in In sheet #1, column I, please feel free to provide any comments.

Please feel free to respond to questions in rows #18 and #19.

Please save your file and return it via email to [rosmin.esmail@ucalgary.ca](mailto:rosmin.esmail@ucalgary.ca)

**Definitions:**

**Knowledge Translation (KT):** a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products, and strengthen the healthcare system (CIHR, 2017)

**Health Technology Reassessment (HTR):** is a structured, evidence-based assessment of the clinical, social, ethical, and economic effects of a technology currently in use to inform its optimal use in comparison to its alternatives (Noseworthy and Clement, 2012)

**Full-Spectrum:** A full-spectrum KT theory, model or framework is one that that has been used in the literature by study authors to inform their KT work and guide all four KT phases: i) planning/design (identifies a knowledge gap, engages stakeholders, develops an intervention), ii) implementation, iii) evaluation, and iv) sustainability/scalability (Strifler et al, 2018)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Name of Full-Spectrum Knowledge  
Translation (KT) Theory, Model, Framework**

Consolidated Framework for Implementation  
Research (CFIR) (Damschroder, 2009)

Stages of Research Evaluation (Nutbeam,  
2006)  
Knowledge-to-Action (KTA) (Graham, 2006)

Quality Implementation Framework (Meyers,  
2012)-link to abstract only  
Western Australia (WA) Health Network Policy  
Development and Implementation Cycle  
(Briggs, 2012)  
Collaborative Model for Achieving  
Breakthrough improvement (Institute for  
Healthcare Improvement, 2003)

Diffusion of Innovations (Rogers, 3rd Edition,  
1983)

Healthcare Improvement Collaborative Model  
(Edward, 2017)  
Co-KT framework (Kitson, 2013)

Plan-Do-Study-Act (PDSA) Cycles (Deming,  
1986)

A Staged Model of Innovation Development  
and Diffusion of Health Promotion Programs  
(Oldenburg, 1996)-link to abstract only

Evidence-Driven Community Health  
Improvement Process (EDCHIP) (Layde,  
2012)  
Reach Effectiveness Adoption Implementation  
Maintenance (RE-AIM) (Glasgow, 1999)

CollaboraKTion framework (Jenkins, 2016)

KT framework for Agency for Healthcare  
Research and Quality (AHRQ) patient safety  
portfolio and grantees (Nieva, 2005)  
Design Focused Implementation Model  
(Ramaswamy, 2018)

**Please feel free to identify any other full-  
spectrum KT theories, models, or  
frameworks that have been missed and  
could be used for HTR**

**Please feel free to identify names of KT or  
HTR experts that could be contacted for  
this study**

For peer review only

**Link to Published KT Theory, Model,  
Framework (if available)**

<https://www.ncbi.nlm.nih.gov/pubmed/19664226>

Book-no link available

<https://onlinelibrary.wiley.com/doi/abs/10.1002/chp.47>

<https://www.ncbi.nlm.nih.gov/pubmed/22644083>

<https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-12-394>

<http://www.ihl.org/resources/Pages/IHIWhitePapers/TheBreakthroughSeriesIHIsCollaborativeModelforAchievingBreakthroughImprovement.aspx>

[https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwjIIPX\\_PffAhU5HjQIHd5MDUkQFjABegQIAhAC&url=https%3A%2F%2Fteddykw2.files.wordpress.com%2F2012%2F07%2Feverett-m-rogers-diffusion-of-innovations.pdf&usg=AOvVaw3NYB0CAj1BlGacLxjbfcf](https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwjIIPX_PffAhU5HjQIHd5MDUkQFjABegQIAhAC&url=https%3A%2F%2Fteddykw2.files.wordpress.com%2F2012%2F07%2Feverett-m-rogers-diffusion-of-innovations.pdf&usg=AOvVaw3NYB0CAj1BlGacLxjbfcf)

<https://academic.oup.com/intqhc/article/29/5/740/4082140>

<https://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-8-54>

<https://deming.org/explore/p-d-s-a>

<https://search.informit.com.au/documentSummary;dn=461377669128445;res=IELAPA>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3489378/>

<https://www.ncbi.nlm.nih.gov/pubmed/10474547>

<https://www.ncbi.nlm.nih.gov/pubmed/27578195>

<https://www.ncbi.nlm.nih.gov/books/NBK20521/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5778695/>

For peer review only



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Familiarity-Are you familiar with the KT, theory, model or framework?**

For peer review only

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Logical Consistency/Plausibility-Does the  
KT theory, model or framework, include  
meaningful, face-valid explanations of  
proposed relationships?**

For peer review only

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Degree of specificity-Does the KT theory, model, or framework include constructs that are comprehensive of implementation determinants or specific to a set of implementation determinants that could be applied to health technology reassessment (HTR)?**

For peer review only

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Accessibility-Would non-experts be able to understand, apply and operationalize the KT theory, model, or framework to HTR?**

For peer review only

For peer review only



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Ease of use-Can the KT theory, model, or framework be used easily?**

For peer review only

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**HTR Suitability-Based on your responses to the previous criteria, is the KT theory, model, framework suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology)?**

For peer review only

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Comments

For peer review only

## Supplementary file 2: Operational Definition of Criteria

Criteria	Operational Definition
<b>Familiarity</b>	Are you familiar with the KT, theory, model or framework?
<b>Logical Consistency/Plausibility</b>	Does the KT theory, model or framework, include meaningful, face-valid explanations of proposed relationships?
<b>Degree of specificity</b>	Does the KT theory, model, or framework include constructs that are comprehensive of implementation determinants or specific to a set of implementation determinants that could be applied to health technology reassessment (HTR)?
<b>Accessibility</b>	Would non-experts be able to understand, apply and operationalize the KT theory, model, or framework to HTR?
<b>Ease of use</b>	Can the KT theory, model, or framework be used easily?
<b>HTR Suitability</b>	Based on your responses to the previous criteria, is the KT theory, model, framework suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology)?

**Supplementary file 3: List of Excluded KT Theories, Models, and Frameworks and Reason of Exclusion (n=20)**

KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)	X			
Interorganizational Relations Theory (Steckler, 2002)	X			
Self-Regulation Theory (Baumeister, 2011)		X		
Social Cognitive Theory (SCT) (Bandura, 1991)			X	
Social Ecology Model for Health Promotion (Stokols, 1992)	X			
Transtheoretical Model of Behaviour Change (Prochaska, 1997)			X	
LEAN transformation process (Lean Enterprise, 2011)		X		
NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)				X
Community Connection model (Liddy, 2013)	X			
Model for accelerating improvement (Associates in Process Improvement Langley, 2009)	X			
Social marketing framework (National Excellence Collaborative, 2003)	X			
Community based KT framework (Campbell, 2010)	X			
Knowledge integration process (Glasgow, 2012)	X			
Precaution Adoption Process model (Weinstein, 2008)	X			
Social learning theory (Bandura, 1952)	X			
CAN-IMPLEMENT (Harrison, 2018)				X (guideline focused)
The translational model of the Black Dog Institute (Werner-Seidler, 2016)	X			
PRECEDE-PROCEED (Green, 2005)	X			

<b>KT Theories, Models and Frameworks Excluded</b>	<b>Too vague</b>	<b>Not pragmatic</b>	<b>Passive</b>	<b>Too Specific</b>
Community to community mentoring model (Liddy, 2013)	X			
Stage theory of organization change (Butterfoss, 2008)	X			

For peer review only



# BMJ Open

## Identification of Knowledge Translation Theories, Models or Frameworks Suitable for Health Technology Reassessment: A Survey of International Experts

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-042251.R1
Article Type:	Original research
Date Submitted by the Author:	19-Apr-2021
Complete List of Authors:	Esmail, Rosmin; University of Calgary Cumming School of Medicine, Community Health Sciences; Alberta Health Services, Hanson, Heather; University of Calgary Cumming School of Medicine; Alberta Health Services, Holroyd-Leduc, Jayna; University of Calgary Cumming School of Medicine; Alberta Health Services, Niven, Daniel; University of Calgary Cumming School of Medicine; Alberta Health Services, Clement, Fiona; University of Calgary Cumming School of Medicine; O'Brien Institute for Public Health
<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	Health policy
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

**Title:**

Identification of Knowledge Translation Theories, Models or Frameworks Suitable for Health Technology Reassessment: A Survey of International Experts

**Author list:**

Rosmin Esmail, BSc, MSc, CHE<sup>1,2,3,4</sup>; rosmin.esmail@ucalgary.ca

Heather M. Hanson, PhD<sup>1,2</sup>; hmhanson@ucalgary.ca

Jayna Holroyd-Leduc, MD, FRCPC<sup>1,2,3,4,5</sup>; jayna.holroyd-leduc@ahs.ca

Daniel J. Niven, MD, MSc, PhD, FRCPC<sup>1,2,3,6</sup>; daniel.niven@ahs.ca

Fiona M. Clement, PhD<sup>1,3</sup>; fclement@ucalgary.ca

1. Department of Community Health Sciences, Cumming School of Medicine, University of Calgary
2. Alberta Health Services, Calgary, Alberta
3. O'Brien Institute for Public Health, University of Calgary, Calgary, Alberta
4. Department of Medicine, Cumming School of Medicine, University of Calgary
5. Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta
6. Department of Critical Care Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta

**Corresponding Author:**

Dr. Fiona M. Clement

3D14A Teaching and Wellness Building

3280 Hospital Drive NW

Calgary, Alberta, T2N 4Z6

Telephone number: 403-210-9373

Email: fclement@ucalgary.ca

1  
2  
3 30 Word count: 4015  
4  
5 31 Figures: 2  
6  
7 32 Tables: 3 (1 box and 2 tables)  
8  
9 33 Supplementary files: 3  
10  
11 34 Supplementary file 1: Survey Instrument  
12  
13 35 Supplementary file 2: Operational Definition of Criteria  
14  
15 36 Supplementary file 3: List of Excluded KT Theories, Models, and Frameworks and Reason of  
16 37 Exclusion from the Modified Delphi Process  
17  
18 38  
19  
20 39  
21  
22 40

1  
2  
3 **41 Abstract:**  
4  
5

6 **42**  
7  
8  
9 **43 Objective:** Health Technology Reassessment (HTR) is a field focused on managing a  
10  
11 **44** technology throughout its lifecycle for optimal use. The process results in one of four possible  
12  
13 **45** recommendations: increase use, decrease use, no change, or complete withdrawal of the  
14  
15 **46** technology. However, implementation of these recommendations has been challenging. This  
16  
17 **47** paper explores knowledge translation (KT) theories, models and frameworks (TMFs) and their  
18  
19 **48** suitability for implementation of HTR recommendations.  
20  
21  
22  
23  
24

25  
26 **50 Design:** Cross-sectional survey  
27  
28  
29  
30

31  
32 **52 Participants:** Purposeful sampling of international KT and HTR experts was administered  
33  
34 **53** between January and March 2019.  
35  
36  
37  
38

39  
40 **55 Methods:** Sixteen full-spectrum KT TMFs were rated by the experts as “yes”, “partially yes”, or  
41  
42 **56** “no” on six criteria: familiarity, logical consistency/plausibility, degree of specificity,  
43  
44 **57** accessibility, ease of use, and HTR suitability. Consensus was determined as a rating of  $\geq 70\%$   
45  
46 **58** responding “yes”. Descriptive statistics and manifest content analysis was conducted on open-  
47  
48 **59** ended comments.  
49  
50  
51  
52

53 **60**  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 61 **Results:** Eleven HTR and 11 KT experts from Canada, US, UK, Australia, Germany, Spain,  
4  
5 62 Italy and Sweden participated. Of the 16 KT TMFs, none received  $\geq 70\%$  rating. When ratings  
6  
7 63 of “yes” and “partially yes” were combined, the Consolidated Framework for Implementation  
8  
9 64 Research (CFIR) was considered the most suitable KT TMF by both KT and HTR experts  
10  
11 65 (86%). One additional KT TMF was selected by KT experts: Knowledge to Action framework.  
12  
13 66 HTR experts selected two additional KT TMFs: co-KT framework and Plan Do Study Act cycle.  
14  
15 67 Experts identified three key characteristics of a KT TMF that may be important to consider:  
16  
17 68 practicality, guidance on implementation, and KT TMF adaptability.  
18  
19  
20  
21  
22  
23

24 70 **Conclusions:** Despite not reaching an overall  $\geq 70\%$  rating on any of the KT TMFs, experts  
25  
26 71 identified four KT TMFs suitable for HTR. Users may apply these KT TMFs in the  
27  
28 72 implementation of HTR recommendations. In addition, KT TMFs characteristics relevant to the  
29  
30 73 field of HTR need to be explored further.  
31  
32  
33

34 74  
35  
36  
37 75 **Key words:** Health Technology Reassessment, Disinvestment, De-adoption, De-  
38  
39 76 implementation, Theories, Models and Frameworks, Knowledge Translation, Implementation  
40  
41 77 Science.  
42  
43  
44

45 78  
46  
47  
48 79  
49  
50  
51 80  
52  
53  
54 81  
55  
56  
57  
58  
59  
60

## 82 Article Summary

### 83 Strengths and Limitations of Study

84

- 85 • This was the first study to solicit the perspectives of international HTR and KT experts  
86 on the suitability of KT TMFs for HTR.
- 87 • Through purposeful sampling, a survey was administered to HTR and KT international  
88 experts.
- 89 • Experts were asked to rate each KT TMF as “yes”, “partially yes”, or “no” on six criteria:  
90 familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of  
91 use, and HTR suitability.
- 92 • Descriptive statistics on ratings for each KT TMF were conducted.
- 93 • Manifest content analysis was applied to open-ended comments.

94

1  
2  
3 95 **Background**  
4

5  
6 96  
7

8  
9 97 Health Technology Reassessment (HTR) is the systematic process of evaluating technologies  
10  
11 98 that are currently in the health system to ensure that they are being used optimally (1).  
12

13  
14 99 Recommendations from the HTR process can result in the increase use, decrease use, no change,  
15  
16 100 or complete withdrawal of the technology (2). However, implementation of these  
17

18 101 recommendations has been challenging (2). It has been argued that the field of knowledge  
19  
20 102 translation (KT) could play a role in the implementation process for HTR recommendations (3).  
21

22  
23 103 KT has been described as “a dynamic and iterative process that includes the synthesis,  
24  
25 104 dissemination, exchange and ethically-sound application of knowledge to improve the health of  
26

27 105 [populations], provide more effective health services and products, and strengthen the healthcare  
28  
29 106 system” (4). In essence, KT is the application of putting knowledge into practice and policy. KT  
30

31  
32 107 approaches could be used in the HTR process to bridge the gap between the generation of  
33  
34 108 recommendations regarding optimal technology use and their implementation in practice (3)  
35

36  
37 109 Thus, KT can be seen as complimentary to the HTR process, but there has been a paucity of  
38  
39 110 research in this area (3). Moreover, there is a gap in our understanding of which KT theories,  
40

41 111 models, or frameworks (KT TMFs hereafter) would be best suited for the translation of HTR  
42  
43 112 recommendations (3).  
44

45  
46  
47 113  
48

49  
50 114 In the literature, two narrative reviews and two scoping reviews have reported from 41 to 159  
51  
52 115 KT TMFs depending on how they are identified and considered (5-8). KT TMFs have been  
53

54 116 used in different contexts, settings, and populations (5-8). Moreover, there has been some use of  
55  
56  
57  
58  
59  
60



the KT interventions, strategies, and TMFs to decrease or remove low value care (9, 10). These KT TMFs have been used to help identify determinants, barriers and enablers to behaviour change related to HTR (11, 12). However, the use of these KT TMFs has not been applied consistently to the development of KT interventions or the field of HTR (3, 13). There are also no recommendations about which KT TMFs could be used for HTR. Through an international survey of KT and HTR experts, this study aims to provide an understanding of which KT TMFs could be appropriate for the HTR process and implementation of its recommendations.

## Methods

This study used three approaches to the selection of KT TMFs for HTR: identification of suitable KT TMFs, consensus on the list of KT TMFs through a modified Delphi process, and selection of potentially suitable KT TMFs through a survey of international KT and HTR experts.

Ethics approval was obtained from the University of Calgary's Conjoint Health Research Ethics Board [REB#17-0932].

## Identification of Suitable KT TMFs

Only full-spectrum KT TMFs were included. "Full-spectrum" includes all four KT phases: planning/design, implementation, evaluation, and sustainability/scalability (8). These four KT

phases are critical to the KT process and are thought to be necessary for the HTR process and implementation of its recommendations (3). A recent scoping review provided a preliminary list of 26 full-spectrum KT TMFs within cancer and chronic disease management contexts (8). A recent update of this scoping review conducted by the authors resulted in 36 full-spectrum KT TMFs identified (14). Eighteen were process models, eight were classic theories, three were determinant frameworks, three were evaluation frameworks, and four fit more than one approach category (14). This list of 36 full-spectrum KT TMFs provided the initial list of KT TMFs to assess for use when implementing HTR recommendations.

**Consensus on the list of KT TMFs using a Modified Delphi Process**

To ensure that the list of 36 full-spectrum KT TMFs was adequate and concise, a convenience sample consisting of the authors of this study reviewed this initial list to determine if any KT TMFs had been missed or could be eliminated based on HTR suitability. This sample was considered suitable as the authors had clinical training combined with expertise in KT or HTR and/or were experts at the doctorate level in these fields. A three-round modified Delphi process was undertaken (15-17). The Delphi process is iterative and used to determine expert group consensus where there is a lack of evidence and expert opinion is important (18). The first and second rounds involved independent review of each KT TMF to determine which would be suitable for HTR. Each author rated the KT TMF as “yes”, “potentially yes”, or “no” for HTR suitability. Consensus to keep the KT TMF was defined as 100% of the authors rating the KT TMF as “yes” and/or “potentially yes”. Consensus to eliminate the KT TMF was defined as

100% of the authors rating the KT TMF as “no”. Any KT TMFs that did not reach consensus were discussed in subsequent rounds. The third round entailed a two-hour face-to-face meeting held in October 2018. Prior to the discussion at this meeting, the authors agreed on ground rules, principles, and criteria for selection of KT TMFs for HTR suitability (Table 1). The authors deliberated on the remaining KT TMFs until consensus was reached. Verbal consent from the participants was obtained prior and the meeting was recorded.

## International Expert Survey

### *Selection of Experts to Review KT TMFs for HTR*

HTR and KT experts were selected through purposive and snowball sampling. Names were initially derived through the KT Canada website, Health Technology Assessment international (HTAi) Disinvestment Interest group, authors of relevant publications, and in consultation with other experts. A list of HTR and KT international experts was generated by country including Canada, US, UK, Australia, and European countries (Germany, Italy, Sweden, Spain). Experts were contacted via email to participate in the study. They were sent an email, invitation letter, and information sheet. If they agreed to participate, they were sent a consent form, a survey with the list of KT TMFs identified by the modified Delphi process to rate (Supplementary file 1), and recent article on the topic as background information (3). If they were unable to participate, the next expert name on the list was contacted. This was done to ensure that there were at least two HTR and two KT experts from each of Canada, US, UK, Australia (n=16) and four HTR and four KT experts from other European countries combined (n=8) for a target sample size of 24.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

182 Experts contacted could also suggest additional names of experts to be surveyed through  
183 snowball sampling. These names were added to the list of experts and contacted, if required, to  
184 reach a pre-defined number of participants. Representativeness was assessed by ensuring that  
185 experts came from different jurisdictions with a depth and breadth of knowledge in both KT and  
186 HTR.

187  
188 **Survey Development**

189  
190 The Enhancing The Quality and Transparency of Health Research (EQUATOR) good practice in  
191 the conduct and reporting of survey research guidelines were followed for the development of  
192 the survey (19). The survey included the list of KT TMFs, a description of each KT TMF,  
193 followed by a link to the paper that described the KT TMF, if one was available. Specific  
194 criteria used previously to select KT TMFs were used to rate each KT TMF (20). These  
195 included: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of  
196 use, and HTR suitability. Each criterion was operationally defined and reviewed by FC and  
197 HMM (Supplementary file 2). There was also a section for open-ended comments. The survey  
198 was developed in Excel and pilot tested by four participants to ensure flow and functionality.

## 203 Survey Administration

204

205 The survey was administered via email to the experts starting in January 2019. Based on the

206 criteria, each KT TMF was rated by each expert as “yes”, “partially yes” or “no” and additional

207 comments could be provided. Experts were also asked to suggest additional full-spectrum KT

208 TMFs that could be suitable for HTR and recommend other experts that could be contacted for

209 the study. Consensus was determined as  $\geq 70\%$  experts selected “yes” for the particular KT

210 TMF. The principles and criteria described in Table 1 were also shared with the international

211 experts for information purposes. Experts were asked to return the survey within two weeks.

212 Two additional reminders were sent. If surveys were not returned, then another expert on the list

213 was contacted to participate. The survey was sent out to experts until March 31, 2019 to ensure

214 that at least two HTR and two KT experts had agreed to complete the survey from the identified

215 countries.

## 217 Data Analysis

### 219 *Modified Delphi Process*

220 After rounds 1 and 2 of the modified Delphi process, data were analyzed descriptively by

221 tabulating the “yes”, “potentially yes”, and “no” responses for HTR suitability for each KT TMF

222 reviewed by the authors.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

*Survey Data*

Survey data were analyzed descriptively by tabulating the “yes”, “partially yes”, and “no” responses for HTR suitability for each KT TMF and by HTR and KT expert sub-groups. KT TMF familiarity and missing data were also descriptively summarized.

Data from the open-ended comments section of the survey provided by the HTR and KT experts were analyzed using content analysis (21). As these data were limited in volume, content analysis was undertaken to provide a starting point in determining preliminary factors that may be important to consider for a KT TMF for HTR.

Initially, all comments from each expert were entered into Excel and categorized by KT TMF. These were read and reread to get familiarized with the data. Next, for each KT TMF, each comment was organized by response to HTR suitability as “yes”, “partially yes”, “no”, and unfamiliar with the KT TMF. This categorization provided an understanding of what comments may or may not be important to consider for HTR suitability. Open coding and constant comparison were applied inductively to all the comments. A preliminary list of codes, sub-codes, and operational definitions were developed manually through independent review of the comments from three KT TMFs (Consolidated Framework for Implementation Research (CFIR), Stages of Research Evaluation, and Knowledge to Action (KTA) framework) by RE and HMM. A final taxonomy consisting of codes, sub-codes, and operational definitions with exemplar quotes was applied manually to the comments for the remaining KT TMFs by RE (Box 1). Manifest content analysis, defined as the development of categories as opposed to latent content analysis (defined as the development of themes), was determined to be best suited given the

248 nature of the open-ended comments (21). Categories were created, grouping codes under higher  
249 order headings, and formulating a general description of these categories. In addition, the  
250 frequency of comments for each code in each category was also tabulated by HTR and KT expert  
251 to determine the top categories/codes. The most prominent codes and interpretation of the data  
252 were determined through frequency counts, discussion, and consensus among FC and HMH.

253

## 254 **Patient and public involvement**

255

256 Patients or the public were not involved in the design, or conduct, or reporting, or dissemination  
257 plans of our research.

258

## 259 **Results**

260

## 261 **Modified Delphi Process**

262

263 The results of the modified Delphi process are presented in Table 2. The third round resulted in  
264 the selection of 16 full-spectrum KT TMFs. There were 12 process models, two frameworks, one  
265 classic theory, and one KT TMF that fit two categories (model and framework). Twenty KT  
266 TMFs were excluded. Fourteen were too vague and not descriptive enough, two were considered  
267 ‘passive’ and not ‘active’ KT TMFs to make change happen, two were not pragmatic, and two  
268 were too specific to a given context (i.e. guideline adaptation and disability research)  
269 (Supplementary file 3).

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**International Expert Survey**

Forty-eight KT experts and 31 HTR experts were invited to participate via email. A total of 22 experts (11 KT and 11 HTR) completed the survey. Experts were from Canada (4), US (5), UK (3), Australia (4), Germany (2), Spain (1), Italy (1), and Sweden (2). Fifty-nine percent were women, and all had graduate-level education (Masters or PhD).

Overall, of the 16 KT TMFs none received a “yes” rating for HTR suitability by  $\geq 70\%$  of the experts. The top three most highly rated KT TMFs were CFIR (22), KTA (23) and the Plan-Do-Study-Act (PDSA) cycle (24). Thirty-eight percent of the experts rated CFIR as “yes”, followed by 27% each for the KTA framework and the PDSA cycle (24). The least rated KT TMFs by the experts were the KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (25), the Stages of Research Evaluation (26), the Staged Model of Innovation Development and Diffusion of Health Promotion Programs (27) which all received 0% ratings for “yes” by the experts (Figure 1). Combination of the “yes” or ‘partially yes’ ratings found that 86% (19/22) of the experts selected CFIR as the top rated KT TMF for HTR suitability (22).

**Stratified analysis by KT and HTR Expertise**

KT experts favored KTA (82%, 9/11) as another KT TMF that would be suitable for HTR (23) in addition to CFIR (91%, 10/11). HTR experts favored the Co-KT Framework (72%, 8/11) (28) and the PDSA cycle, (72%, 8/11) (24) in addition to CFIR (82%, 9/11).



## 293 Content Analysis

294

295 Forty-nine percent of the comments provided by both KT and HTR experts were related to the  
296 TMF characteristics category, followed by the TMF attributes category (19%). Implementation  
297 and user categories both had 13% each (Figure 2).

298

299 Overall, the top code was “pragmatic” under the TMF characteristics category (14%) defined as  
300 the KT TMF not being theoretical but practical and application of the TMF outside of research or  
301 academic settings. This was followed by implementation (13%), defined as the KT TMF  
302 provides operation detail on how to ‘do’ the implementation to achieve the HTR outputs. This  
303 included exploring determinants, their inter-relationships, and the development of interventions  
304 or strategies based on these determinants. The third top code was HTR suitability under the TMF  
305 attributes category (8%), defined as a ‘strong fit’ to HTR and its determinants. It also included  
306 the ability to adapt the KT TMF and tailor it to micro (individual), meso (organizational), and  
307 macro (policy) levels (3).

308

309 More KT experts than HTR experts commented on pragmatic as an important characteristic for a  
310 KT TMF (56% versus 44%). There were both positive and negative comments related to  
311 pragmatic for a KT TMF that would make it suitable for HTR. For example, one KT expert who  
312 said “yes” to HTR suitability for the PDSA cycle noted the following positive affect:

313

314 “A basic, simple but still very useful approach” [009].

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

315 In contrast, in reference to the Stages of Research Evaluation, one HTR expert who said ‘no’ to  
316 HTR suitability stated the following negative affect:

317  
318 “This is also difficult to be implemented in reality as it is far from explaining the  
319 characteristics of the healthcare systems and professional interactions” [017].

320  
321 More KT experts than HTR experts provided comments related to implementation (78% versus  
322 22%). There were both positive and negative affects of comments related to implementation for a  
323 KT TMF that would make it suitable for HTR. One KT expert who said “yes” to HTR suitability  
324 for the Quality Implementation framework stated the following positive affect:

325  
326 “I’m not familiar with specifics about this framework; it certainly covers the full-  
327 spectrum of considerations for implementing new interventions; could be adapted for de-  
328 adoption/implementation “[005].

329  
330 On the contrary, another KT expert who said ‘no’ to HTR suitability with respect to Diffusion of  
331 Innovation theory stated the following negative affect:

332  
333 “I think (as it is a general theory rather than an implementation framework/model) that it  
334 lacks sufficient guidance on how to implement/de-implement” [007].

335  
336 More KT experts provided comments to HTR suitability than HTR experts (60% versus 40%).  
337 There were both positive and negative affects of comments related to HTR suitability for a KT

338 TMF. One HTR expert who said partially “yes” to HTR suitability for CFIR stated the following  
339 positive affect:

340  
341 “A lot of constructs have been included in CFIR, so in each case, it would probably  
342 require selection of the specific ones relevant for the HTR example” [021].

343  
344 Whereas another KT expert who said ‘no’ to HTR suitability for the CollaboraKTion framework  
345 stated:

346  
347 “Depends on focus of work-this emphasizes need for community to decide on action  
348 whereas if you had a particular output in mind to implement/de-implement this might not  
349 be the best fit” [001].

350  
351 However, HTR experts commented more on the ability to tailor the KT TMF to micro, meso,  
352 macro levels than KT experts (90% versus 10%).

353

## 354 Discussion

355

## 356 Key Findings

357

358 The focus of this study was to determine KT TMFs that could be suitable for implementation of  
359 HTR recommendations. Three key findings emerged: 1)  $\geq 70\%$  consensus (rated as “yes” by  
360 the experts) was not reached by the international KT and HTR experts on any of the current full-

1  
2  
3 361 spectrum KT TMFs; however when ratings of “yes” and “partially yes” were combined, CFIR  
4  
5 362 was considered the most suitable KT TMF by both KT and HTR experts; 2) KT experts  
6  
7 363 identified one additional KT TMF: KTA framework, whereas HTR experts identified two  
8  
9 364 additional KT TMFs: co-KT framework and PDSA cycle as potentially suitable for HTR ; and 3)  
10  
11 365 Overall, experts commented on three key characteristics of a KT TMF that may be important to  
12  
13 366 consider: practicality, guidance on how to implement, and adaptability of the KT TMF to HTR.  
14  
15  
16  
17 367  
18

19 368 **Strengths**

20  
21 369  
22  
23  
24 370 This study utilized a modified Delphi process and survey to illicit input from study authors and  
25  
26 371 international KT and HTR experts. Although, experts may not have sufficient knowledge of all  
27  
28 372 the KT TMFs, this was the first study that attempted to garner the opinions of experts in both  
29  
30 373 fields. The field of KT and its application to HTR has been proposed as a mechanism to  
31  
32 374 advance the implementation of HTR recommendations into practice (3). The selection of one  
33  
34 375 determinant framework (CFIR), and three process models (KTA framework, co-KT framework,  
35  
36 376 and the PDSA cycle) provides a starting point of potential KT TMFs that could be used with  
37  
38 377 HTR. However, as  $\geq 70\%$  consensus was not reached by the experts, these findings need to be  
39  
40 378 considered as preliminary.  
41  
42  
43  
44

45 379  
46  
47 380 **Limitations**

48  
49 381  
50  
51 382 The Delphi technique has been criticized for lack of guidelines on the determination of the size  
52  
53 383 of the expert panel, lack of anonymity, what is meant by ‘expert’ opinion, and determination on  
54  
55  
56  
57  
58  
59  
60

the level of consensus (29). The sample size of five may have been too small to select KT TMFs from the list of 36 full-spectrum KT TMFs. The 100% consensus level may have been too high. There may also have been pressures of conformity at the face-to-face meeting. However, the authors had a wide-range of expertise in HTR, KT or both. The use of a facilitator and establishment of ground rules, and principles upfront were important considerations to address pressures of conformity.

Although purposeful sampling was used for the survey, the sample size of international KT and HTR experts was small which may have reduced the ability to generate consensus. However, considerable efforts were made to target experts with knowledge and practical experience in KT and/or HTR. Lastly, the selection of 70% consensus was arbitrary and determined a priori to survey administration. This level of agreement has been considered appropriate in previous Delphi studies (30), but there is no acceptable level of consensus (29).

### **Implications of Findings**

Among the list of 16 full-spectrum KT TMFs identified through a modified Delphi process, the international experts were not able to select a current KT TMF for HTR. Lack of familiarity with the KT TMFs could be one reason. Specifically, experts were not familiar enough with four of the 16 KT TMFs to rate them for HTR suitability. Over recent years, there has been a flurry of KT TMFs developed (8). This proliferation of KT TMFs makes it challenging for experts to keep abreast of them. Moreover, there has been criticism of the development of KT TMFs

1  
2  
3 406 without adequate testing, validation and research (31). Experts within the KT field may lean  
4  
5 407 towards those KT TMFs that they are most familiar with (8).  
6  
7 408  
8  
9  
10 409 Another reason experts were challenged to select a KT TMF may be the lack of understanding of  
11  
12 410 the HTR process. KT experts in particular, may have found it difficult to review the KT TMFs  
13  
14 411 and then apply them to HTR, as they may not be familiar enough with the HTR process itself.  
15  
16 412 HTR has also been confused with terms such as ‘disinvestment’ and ‘de-adoption’, which are  
17  
18 413 considered outcomes of the HTR process rather than the process itself (2). In addition, the field  
19  
20 414 of HTR is under-developed and concepts have yet to be agreed upon (3). An information sheet  
21  
22 415 and background paper with a description of the fields of KT and HTR was provided to the  
23  
24 416 experts prior to the survey. However, these materials may not have been reviewed in advance or  
25  
26 417 been a sufficient knowledge resource.  
27  
28  
29  
30  
31 418  
32  
33 419 CFIR was the only KT TMF selected by both HTR and KT experts as a potential KT TMF that  
34  
35 420 could be used for HTR. CFIR has been used widely and is a well-operationalized, multi-level  
36  
37 421 implementation determinant framework derived from theory (32, 33). The application of CFIR  
38  
39 422 and its constructs may enable users to assess facilitators and barriers to the implementation of  
40  
41 423 HTR recommendations, particularly when HTR recommendations result in decreased use or  
42  
43 424 removal of the technology. The assessment of facilitators and barriers has been noted as an  
44  
45 425 important step within the de-adoption process of low value care (3, 34). However, future  
46  
47 426 research with a focus on the application of CFIR to HTR projects is needed.  
48  
49  
50  
51 427

1  
2  
3 428 The KTA framework was primarily selected as suitable for HTR by KT experts. Its selection  
4  
5 429 could be due to its wide-spread use in the KT field (35, 36). In fact, one adaptation of the KTA  
6  
7 430 framework has been the Synthesis Framework for Facilitating De-adoption (34). This  
8  
9 431 framework has been proposed for potential use in HTR projects (3). However, it has yet to be  
10  
11 432 applied in practice. Nonetheless, the KTA framework's ability to be adaptable may be another  
12  
13 433 factor in its selection primarily by KT experts.  
14  
15  
16  
17 434

18  
19 435 The co-KT framework (28) and PDSA cycle (24) were primarily selected for HTR suitability by  
20  
21 436 HTR experts. Both are process models (14). The co-KT framework is a linear process and may  
22  
23 437 be considered simplistic to apply. The PDSA cycle has been used extensively in quality  
24  
25 438 improvement as a model for change (37). It is a simple and pragmatic model to use and is  
26  
27 439 adaptable within other models (38). However, it is not without its limitations (37).  
28  
29  
30 440 Subsequently, selection of these KT TMFs by HTR experts may be due their ease of use.  
31  
32  
33 441  
34  
35 442

### 36 443 **Implications for Future Research**

37  
38 444

39  
40 445 Although not the key focus of this study, three key characteristics: practicality, guidance on how  
41  
42 446 to implement; and adaptability of the KT TMF to HTR were identified from the open-ended  
43  
44 447 comments. These key characteristics and others maybe important to further interrogate. ,  
45  
46 448 Future research on identifying the key elements, attributes, constructs of KT TMFs for HTR  
47  
48 449 through expert interviews is needed to better understand which would influence and demonstrate  
49  
50 450 an important role for HTR.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

451 Recently, there has also been a proliferation of disinvestment frameworks or frameworks to  
452 address overuse (13, 39, 40). Some are based on KT and Implementation Science principles  
453 (13). The focus of these frameworks has been on removing or reducing low value care from  
454 practice. The application of these frameworks is still in its infancy. Although, the list of full-  
455 spectrum KT TMFs that were examined in this study did not consider these disinvestment  
456 frameworks, there may be merit in doing so.

457  
458 **Conclusion**

459  
460 This study provided insights into which KT TMFs may be suitable for HTR. Despite not  
461 attaining  $\geq 70\%$  rated as “yes” on any of the KT TMFs through the survey, experts identified  
462 four KT TMFs that could potentially be used within the context of HTR (CFIR, KTA, co-KT,  
463 and PDSA). Familiarity, adaptability and ease of use may be some of the reasons that led to their  
464 selection. Moreover, characteristics of practicality, how to implement HTR recommendations,  
465 and adaptability of the KT TMF to HTR need to be interrogated to determine if they are  
466 important in a KT TMF for HTR. The process of HTR could benefit from the field of KT and  
467 its application of KT TMFs in implementation of its recommendations. Future research on the  
468 application of KT TMFs to HTR projects will provide much needed guidance and advancement  
469 in this area.



471 **Competing Interests:** None.

472

473 **Funding:** Rosmin Esmail is funded through an Alberta Innovates – Health Solutions Graduate  
474 Studentship Award. The funding body did not participate in the design of the study and  
475 collection, analysis, and interpretation of data or writing of the manuscript.

476 **Award/grand number-**Not Applicable

477

478 **Data Availability:** All data relevant to the study are included in the article or uploaded as  
479 supplementary information.

480

481 **Contributors:** Rosmin Esmail conducted the study, collected, analyzed, and interpreted the data.  
482 Rosmin Esmail, Fiona Clement and Heather Hanson drafted the manuscript. Rosmin Esmail,  
483 Fiona Clement, Heather Hanson, Jayna Holroyd-Leduc and Daniel J Niven contributed to the  
484 study conception and design, planning, data interpretation, and were involved in revising the  
485 manuscript for important intellectual content. Rosmin Esmail, Fiona Clement, Heather Hanson,  
486 Jayna Holroyd-Leduc and Daniel J Niven read, provided edits, and approved the final  
487 manuscript.

488

489 **Acknowledgments:** We would like to thank all the individuals that participated in this study for  
490 their support and contributions to this work.

491

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Ethics Statement:** Ethics approval was obtained from the University of Calgary’s Conjoint Health Research Ethics Board [REB#17-0932]. Participants were provided with a background study information sheet and provided written informed consent before taking part in the study.

For peer review only

## References:

1. Noseworthy T, Clement FM. Health Technology Reassessment: Scope, Methodology, & Language. *Int J Technol Assess Health Care*. 2012;28(3):201-2.
2. Soril L, MacKean G, Noseworthy TM, Leggett LE, Clement FM. Achieving Optimal Technology Use: A proposed model for health technology reassessment. *Sage Open Medicine*. 2017;5:1-7.
3. Esmail R, Hanson H, Holyrody-Leduc J, Niven DJ, Clement F. Knowledge translation and health technology reassessment: identifying synergy. *BMC Health Serv Res*. 2018;18:674.
4. Canadian Institutes of Health Research. Knowledge Translation. 2017 [Available from: <http://www.cihr-irsc.gc.ca/e/29529.html>].
5. Lokker C, McKibbon KA, Colquhoun H, Hempel S. A scoping review of classification schemes of interventions to promote and integrate evidence into practice in healthcare. *Implement Sci*. 2015;10:27.
6. Milat AJ, Li B. Narrative review of frameworks for translating research evidence into policy and practice. *Public Health Res Pract*. 2017;27(1):1-13.
7. Tabak RG, Khoong EC, Chambers DA, Brownson RC. Bridging research and practice: models for dissemination and implementation research. *Am J Prev Med*. 2012;43(3):337-50.
8. Striffler L, Cardoso R, McGowan J, Cogo E, Nincic V, Khan PA, et al. Scoping review identifies number of knowledge translation theories, models and frameworks with limited use. *Journal of Clinical Epidemiology*. 2018;100:92-102.
9. Colla CH, Mainor AJ, Hargreaves C, Sequist T, Morden N. Interventions Aimed at Reducing Use of Low-Value Health Services: A Systematic Review. *Medical Care Research and Review*. 2017;74(5):507-50.
10. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci*. 2012;7(1):37.
11. French SD, Green SE, O'Connor DA, McKenzie JE, Francis JJ, Michie S, et al. Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implement Sci*. 2012;7(1):38.
12. Soril LJJ, Noseworthy TW, Stelfox HT, Zygun DA, Clement FM. Facilitators of and barriers to adopting a restrictive red blood cell transfusion practice: a population-based cross-sectional survey. *CMAJ open*. 2019;7(2):E252-E7.
13. Grimshaw JM, Patey AM, Kirkham KR, Hall A, Dowling SK, Rodondi N, et al. De-implementing wisely: developing the evidence base to reduce low-value care. *BMJ Qual Saf*. 2020:bmjqs-2019-010060.
14. Esmail R, Hanson HM, Holroyd-Leduc J, Brown S, Striffler L, Straus SE, et al. A scoping review of full-spectrum knowledge translation theories, models, and frameworks. *Implement Sci*. 2020;15(1):11.
15. Dalkey NC. The Delphi Method: An experimental study of group opinion. RM-58888-PR TRCP, editor. Santa Monica. 1969.
16. Dalkey NC, Helmer O. An experimental application of the Delphi method to the use of experts. *Manag Sci* 1963;9(3):458-67.
17. Hsu CC, Sanford BA. The Delphi Technique: Making Sense Of Consensus. *Practical Assessment Research & Evaluation*. 2007;12(10):2-8.

1  
2  
3 542 18. Meshkat B, Cowman S, Gethin G, Ryan K, Wiley M, Brick A, et al. Using an e-Delphi  
4 543 technique in achieving consensus across disciplines for developing best practice in day surgery  
5 544 in Ireland. *J Hosp Adm.* 2014;3(4):1-8.  
6 545 19. Kelley K, Clark B, Brown V, Sitzia J. Good practice in the conduct and reporting of  
7 546 survey research. *Int J Qual Health Care.* 2003;15(3):261-6.  
8 547 20. Birken SA, Powell BJ, Shea CM, Haines ER, Kirk MA, Leeman J, et al. Criteria for  
9 548 selecting implementation science theories and frameworks: results from an international survey.  
10 549 *Implement Sci.* 2017;12:124.  
11 550 21. Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis:  
12 551 Implications for conducting a qualitative descriptive study. *Nurs Health Sci.* 2013;15(3):398-  
13 552 405.  
14 553 22. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering  
15 554 implementation of health services research findings into practice: a consolidated framework for  
16 555 advancing implementation science. *Implement Sci.* 2009;4(1):50.  
17 556 23. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, et al. Lost in  
18 557 knowledge translation: time for a map? *J Contin Educ Health Prof.* 2006;26(1):13-24.  
19 558 24. Deming W. Plan-Do-Study-Act (PDSA) Cycles 1986 [Available from:  
20 559 <https://deming.org/explore/p-d-s-a>]  
21 560 25. Nieva VF MR, Ridley N, et al. From Science to Service: A Framework for the Transfer  
22 561 of Patient Safety Research into Practice. . United States: In: Henriksen K, Battles JB, Marks ES,  
23 562 et al., editors. *Advances in Patient Safety: From Research to Implementation (Volume 2:  
24 563 Concepts and Methodology)*. Rockville (MD): Agency for Healthcare Research and Quality  
25 564 2005 Feb.  
26 565 26. Nutbeam D, Bauman AE. *Evaluation in a Nutshell: A Practical Guide to the Evaluation  
27 566 of Health Promotion Programs*: McGraw-Hill; 2006.  
28 567 27. Oldenburg BF, Hardacker C, Ffrench ML. How does Research Contribute to Evidence-  
29 568 based Practice in Health Promotion? *Health Promot J Aust.* 1996;6(2):15-20.  
30 569 28. Kitson A, Powell K, Hoon E, Newbury J, Wilson A, Beilby J. Knowledge translation  
31 570 within a population health study: how do you do it? *Implement Sci.* 2013;8(1):54.  
32 571 29. The Delphi Technique. *The Delphi Technique in Nursing and Health Research.* p. 1-17.  
33 572 30. Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, et al. Defining  
34 573 consensus: A systematic review recommends methodologic criteria for reporting of Delphi  
35 574 studies. *Journal of Clinical Epidemiology.* 2014;67(4):401-9.  
36 575 31. Wensing M, Grol R. Knowledge translation in health: how implementation science could  
37 576 contribute more. *BMC Medicine.* 2019;17(1):88.  
38 577 32. Birken SA, Powell BJ, Presseau J, Kirk MA, Lorencatto F, Gould NJ, et al. Combined  
39 578 use of the Consolidated Framework for Implementation Research (CFIR) and the Theoretical  
40 579 Domains Framework (TDF): a systematic review. *Implementation science : IS.* 2017;12(1):2.  
41 580 33. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic  
42 581 review of the use of the Consolidated Framework for Implementation Research. *Implementation  
43 582 science : IS.* 2016;11:72-.  
44 583 34. Niven DJ, Mrklas KJ, Holodinsky JK, Straus SE, Hemmelgarn BR, Jeffs LP, et al.  
45 584 Towards understanding the de-adoption of low-value clinical practices: a scoping review. *BMC  
46 585 Medicine.* 2015;13(1):255.  
47 586 35. Field B, Booth A, Illott I, Gerrish K. Using the Knowledge to Action Framework in  
48 587 practice: a citation analysis and systematic review. *Implement Sci.* 2014;9(1):172.

36. Esmail R, Hanson H, Holroyd-Leduc J, Brown S, Strifler L, Straus S, et al. A Scoping Review of Full-Spectrum Knowledge Translation Theories, Models and Frameworks - draft manuscript. 2020.
37. Reed JE, Card AJ. The problem with Plan-Do-Study-Act cycles. *BMJ Quality & Safety*. 2016;25(3):147-52.
38. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Quality & Safety*. 2014;23(4):290.
39. Norton WE, Chambers DA, Kramer BS. Conceptualizing De-Implementation in Cancer Care Delivery. *Journal of Clinical Oncology*. 2019;37(2):93-6.
40. Parchman ML, Henrikson NB, Blasi PR, Buist DS, Penfold R, Austin B, et al. Taking action on overuse: Creating the culture for change. *Healthc (Amst)*. 2017;5(4):199-203.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

602     **Table 1: List of Criteria Developed by Authors for Round 3 of Modified Delphi Process**

Criteria
The KT TMFs must have face validity (KT TMFs that are common and well-known should be included)
The KT TMFs must be active KT TMFs (passive KT TMFs were excluded)
The KT TMF must be feasible to apply to take something out of practice
The KT TMF was pragmatic (theoretical KT TMFs were excluded)
The KT TMF must be specific (vague or those that were not prescriptive were excluded)
The KT TMF could build on other KT TMFs but needed to be generic rather than for a specific context
The KT TMF is easily understood and practical
Any KT TMF that the committee was undecided on

603

**Box 1: Taxonomy of Codes and Sub-codes for Comments Provided in the Survey**

Implementation	TMF Characteristics	TMF Attributes	User	Survey Logistics/General Comments
Codes in a KT TMF related to implementation of HTR	Codes related to elements or components in a KT TMF for HTR	Codes that are considered foundational in a KT TMF for to HTR	Codes related to the use of TMFs for HTR from a user perspective	Codes related to the process of survey administration or extraneous
<ul style="list-style-type: none"> <li>Implementation               <ul style="list-style-type: none"> <li>Development of intervention or strategies</li> <li>Inter-related determinants</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Pragmatic real world application</li> <li>Straightforward</li> <li>Engagement of relevant (patient, public, clinician) stakeholders               <ul style="list-style-type: none"> <li>Synchronicity</li> </ul> </li> <li>Lack specificity/insufficient details</li> <li>Complexity</li> <li>Prioritization of HTR</li> <li>Resources such as economic, evidence, funding, local factors.               <ul style="list-style-type: none"> <li>Additional support</li> </ul> </li> <li>Adaptation               <ul style="list-style-type: none"> <li>Additional TMFs</li> </ul> </li> <li>Sustainability</li> <li>Evaluation</li> <li>Influential               <ul style="list-style-type: none"> <li>Originality (face validity)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>HTR Suitability</li> <li>Consideration of alternatives</li> <li>Ability to tailor or applicability micro/meso/macro levels</li> <li>Centrality evidence</li> <li>Contextual fit</li> <li>Motivation               <ul style="list-style-type: none"> <li>Challenge of removing something (feasible to apply -take something out of practice)</li> </ul> </li> <li>Values</li> <li>Generalizability</li> <li>Not a KT TMF</li> </ul>	<ul style="list-style-type: none"> <li>Familiarity</li> <li>Access</li> <li>Use by novices</li> </ul>	<ul style="list-style-type: none"> <li>Survey process/method oriented</li> <li>Non-dated data</li> </ul>

**Table 2: Summary Results of KT Theories, Models and Frameworks Included and Excluded from Rounds 1 to 3 of the Modified Delphi Process**

Included in Round 1	Excluded in Round 1
Consolidated Framework for Implementation Research (CFIR) (Damschroder, 2009)	A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)
Stages of research evaluation (Nutbeam, 2006)	Interorganizational Relations Theory (Steckler, 2002)
Knowledge-to-Action (KTA) (Graham, 2006)	Self-Regulation Theory (Baumeister, 2011)
Quality Implementation Framework (Meyers, 2012)	Social Cognitive Theory (SCT) (Bandura, 1991)
Western Australia (WA) Health Network Policy Development and Implementation Cycle (Briggs, 2012)	Social Ecology Model for Health Promotion (Stokols, 1992)
	Transtheoretical Model of Behaviour Change (Prochaska, 1997)
Included in Round 2	Excluded in Round 2
Collaborative model for achieving breakthrough improvement (Institute for Healthcare Improvement, 2003)	LEAN transformation process (Lean Enterprise, 2011)
Included in Round 3	Excluded in Round 3
Diffusion of Innovations (Rogers, 1983)	NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)
Healthcare Improvement Collaborative Model (Edward, 2017)	Community Connection model (Liddy, 2013)
Co-KT framework (Kitson, 2013)	Model for accelerating improvement (Associates in Process Improvement Langley, 2009)
Plan-do-study-act cycle (Deming, 1986)	Social marketing framework (National Excellence Collaborative, 2003)
A staged model of innovation development and diffusion of health promotion programs (Oldenburg, 1996)	Community-based Knowledge Translation framework (Campbell, 2010)
Evidence-driven community health improvement process (EDCHIP) (Layde, 2012)	Knowledge integration process (Glasgow, 2012)
RE-AIM (Glasgow, 1999)	Precaution Adoption Process model (Weinstein, 2008)
CollaboraKTion framework (Jenkins, 2016)	Social learning theory (Bandura, 1952)
KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (Nieva, 2005)	CAN-IMPLEMENT (Harrison, 2018)



Design focused implementation model (Ramaswamy, 2018)	The translational model of the Black Dog Institute (Werner-Seidler, 2016)
	PRECEDE-PROCEED (Green, 2005)
	Community to community mentoring model (Liddy, 2013)
	Stage theory of organizational change (Butterfoss, 2008)
<b>Total Included=16</b>	<b>Total Excluded=20</b>

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

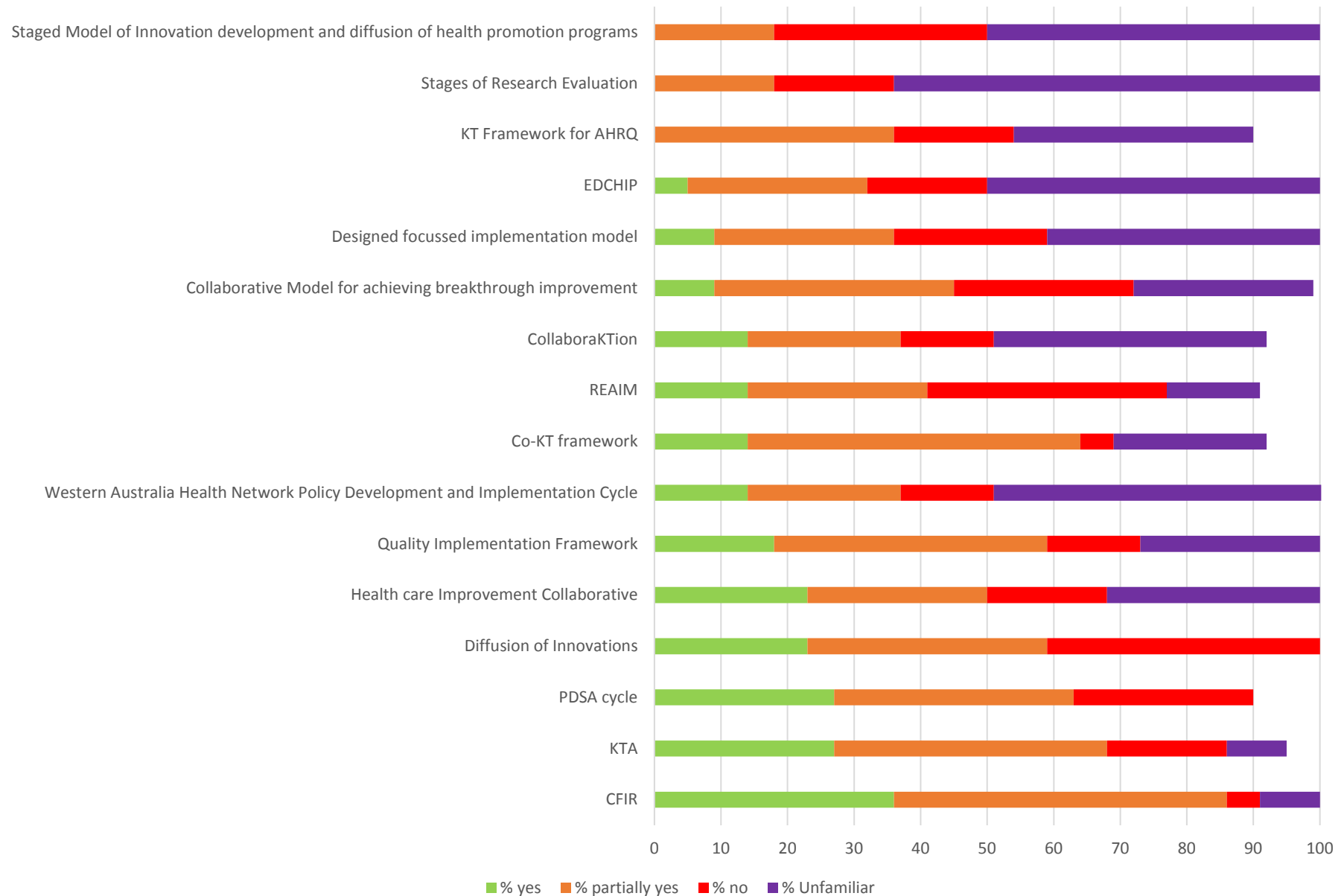
**Figure legend**

Figure 1: HTR Suitability of KT Theories, Models, Frameworks (TMFs) by all Experts

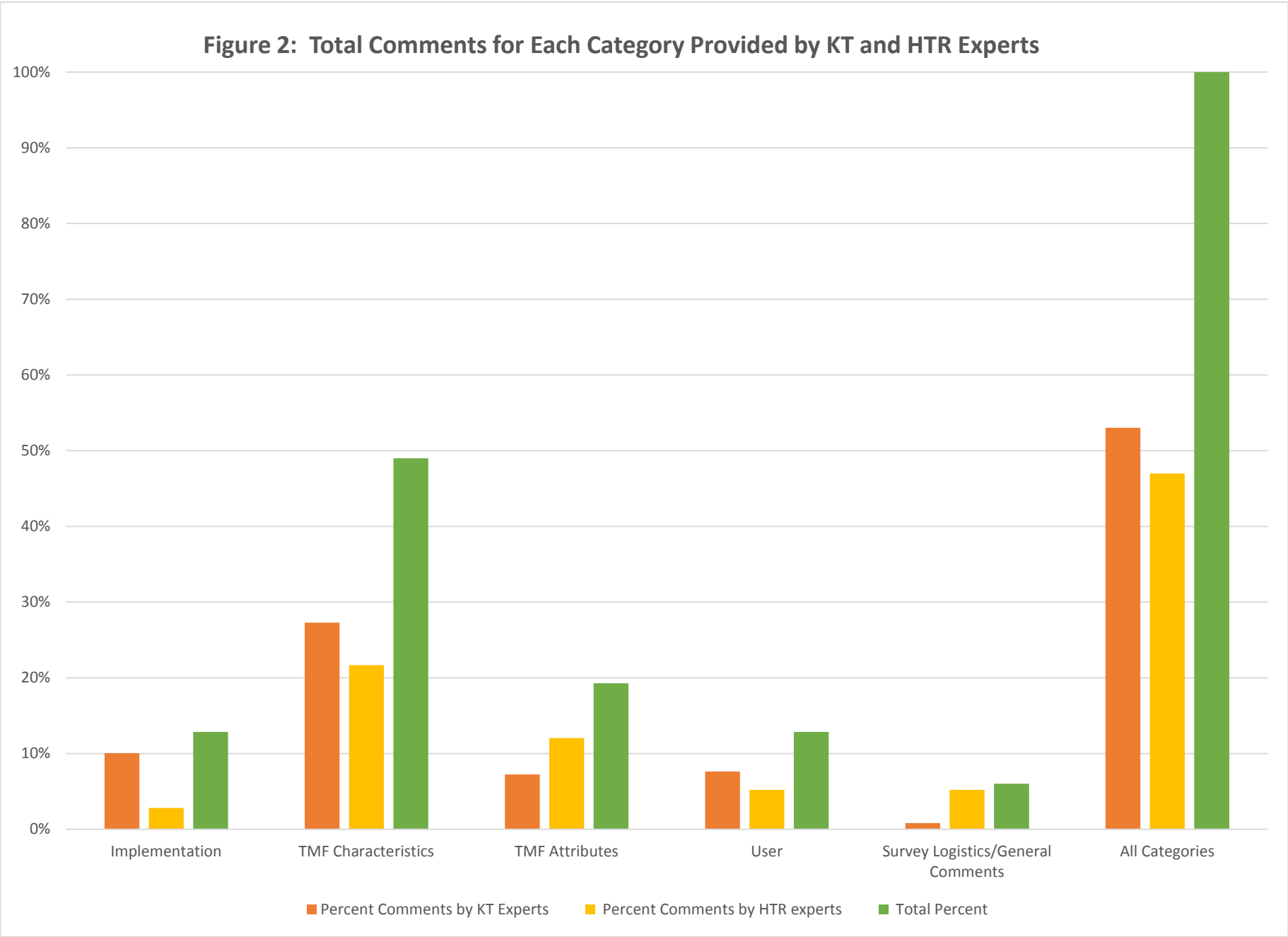
Figure 2: Total Comments for Each Category Provided by KT and HTR Experts

For peer review only

**Figure 1: HTR Suitability of KT Theories, Models, Frameworks (TMFs) by all Experts**



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47



**Instructions:**

Dear Expert, there are 16 full-spectrum KT theories, models and frameworks to review in column A. A brief description of each KT theory, model, framework is provided through a comment box (red triangle in corner of the cell) and a link to the paper, if available, in column B. For each full-spectrum Knowledge Translation (KT ) theory, model or framework please review each criteria in sheet #1 columns C to G and rate as yes, partially yes, or no using the drop box menu.

In sheet #1, based on your responses to columns C to G, please determine if that KT theory, model or framework is suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology) and indicate your response as yes, partially yes, or no using the drop box menu in column H.

In sheet #1, column I, please feel free to provide any comments.

Please feel free to respond to questions in rows #18 and #19.

Please save your file and return it via email to [rosmin.esmail@ucalgary.ca](mailto:rosmin.esmail@ucalgary.ca)

**Definitions:**

**Knowledge Translation (KT):** a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products, and strengthen the healthcare system (CIHR, 2017)

**Health Technology Reassessment (HTR):** is a structured, evidence-based assessment of the clinical, social, ethical, and economic effects of a technology currently in use to inform its optimal use in comparison to its alternatives (Noseworthy and Clement, 2012)

**Full-Spectrum:** A full-spectrum KT theory, model or framework is one that that has been used in the literature by study authors to inform their KT work and guide all four KT phases: i) planning/design (identifies a knowledge gap, engages stakeholders, develops an intervention), ii) implementation, iii) evaluation, and iv) sustainability/scalability (Strifler et al, 2018)



## Supplementary file 2: Operational Definition of Criteria

Criteria	Operational Definition
<b>Familiarity</b>	Are you familiar with the KT, theory, model or framework?
<b>Logical Consistency/Plausibility</b>	Does the KT theory, model or framework, include meaningful, face-valid explanations of proposed relationships?
<b>Degree of specificity</b>	Does the KT theory, model, or framework include constructs that are comprehensive of implementation determinants or specific to a set of implementation determinants that could be applied to health technology reassessment (HTR)?
<b>Accessibility</b>	Would non-experts be able to understand, apply and operationalize the KT theory, model, or framework to HTR?
<b>Ease of use</b>	Can the KT theory, model, or framework be used easily?
<b>HTR Suitability</b>	Based on your responses to the previous criteria, is the KT theory, model, framework suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology)?

**Supplementary file 3: List of Excluded KT Theories, Models, and Frameworks and Reason of Exclusion from the Modified Delphi Process (n=20)**

KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)	X			
Interorganizational Relations Theory (Steckler, 2002)	X			
Self-Regulation Theory (Baumeister, 2011)		X		
Social Cognitive Theory (SCT) (Bandura, 1991)			X	
Social Ecology Model for Health Promotion (Stokols, 1992)	X			
Transtheoretical Model of Behaviour Change (Prochaska, 1997)			X	
LEAN transformation process (Lean Enterprise, 2011)		X		
NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)				X
Community Connection model (Liddy, 2013)	X			
Model for accelerating improvement (Associates in Process Improvement Langley, 2009)	X			
Social marketing framework (National Excellence Collaborative, 2003)	X			
Community based KT framework (Campbell, 2010)	X			
Knowledge integration process (Glasgow, 2012)	X			
Precaution Adoption Process model (Weinstein, 2008)	X			
Social learning theory (Bandura, 1952)	X			
CAN-IMPLEMENT (Harrison, 2018)				X (guideline focused)
The translational model of the Black Dog Institute (Werner-Seidler, 2016)	X			
PRECEDE-PROCEED (Green, 2005)	X			



KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
Community to community mentoring model (Liddy, 2013)	X			
Stage theory of organization change (Butterfoss, 2008)	X			

For peer review only

# BMJ Open

## Identification of Knowledge Translation Theories, Models or Frameworks Suitable for Health Technology Reassessment: A Survey of International Experts

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2020-042251.R2
Article Type:	Original research
Date Submitted by the Author:	18-May-2021
Complete List of Authors:	Esmail, Rosmin; University of Calgary Cumming School of Medicine, Community Health Sciences; Alberta Health Services, Hanson, Heather; University of Calgary Cumming School of Medicine; Alberta Health Services, Holroyd-Leduc, Jayna; University of Calgary Cumming School of Medicine; Alberta Health Services, Niven, Daniel; University of Calgary Cumming School of Medicine; Alberta Health Services, Clement, Fiona; University of Calgary Cumming School of Medicine; O'Brien Institute for Public Health
<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	Health policy, Health services research
Keywords:	EPIDEMIOLOGY, PUBLIC HEALTH, HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™  
Manuscripts



I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our [licence](#).

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which [Creative Commons](#) licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

**Title:**

Identification of Knowledge Translation Theories, Models or Frameworks Suitable for Health Technology Reassessment: A Survey of International Experts

**Author list:**

Rosmin Esmail, BSc, MSc, CHE<sup>1,2,3,4</sup>; rosmin.esmail@ucalgary.ca

Heather M. Hanson, PhD<sup>1,2</sup>; hmhanson@ucalgary.ca

Jayna Holroyd-Leduc, MD, FRCPC<sup>1,2,3,4,5</sup>; jayna.holroyd-leduc@ahs.ca

Daniel J. Niven, MD, MSc, PhD, FRCPC<sup>1,2,3,6</sup>; daniel.niven@ahs.ca

Fiona M. Clement, PhD<sup>1,3</sup>; fclement@ucalgary.ca

1. Department of Community Health Sciences, Cumming School of Medicine, University of Calgary
2. Alberta Health Services, Calgary, Alberta
3. O'Brien Institute for Public Health, University of Calgary, Calgary, Alberta
4. Department of Medicine, Cumming School of Medicine, University of Calgary
5. Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta
6. Department of Critical Care Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta

**Corresponding Author:**

Dr. Fiona M. Clement

3D14A Teaching and Wellness Building

3280 Hospital Drive NW

Calgary, Alberta, T2N 4Z6

Telephone number: 403-210-9373

Email: fclement@ucalgary.ca

1  
2  
3 30 Word count: 4015  
4  
5 31 Figures: 2  
6  
7 32 Tables: 3 (1 box and 2 tables)  
8  
9 33 Supplementary files: 3  
10  
11 34 Supplementary file 1: Survey Instrument  
12  
13 35 Supplementary file 2: Operational Definition of Criteria  
14  
15 36 Supplementary file 3: List of Excluded KT Theories, Models, and Frameworks and Reason of  
16 37 Exclusion from the Modified Delphi Process  
17  
18 38  
19  
20 39  
21  
22 40

1  
2  
3 **41 Abstract:**  
4  
5

6 **42**  
7  
8  
9 **43 Objective:** Health Technology Reassessment (HTR) is a field focused on managing a  
10  
11 **44** technology throughout its lifecycle for optimal use. The process results in one of four possible  
12  
13 **45** recommendations: increase use, decrease use, no change, or complete withdrawal of the  
14  
15 **46** technology. However, implementation of these recommendations has been challenging. This  
16  
17 **47** paper explores knowledge translation (KT) theories, models and frameworks (TMFs) and their  
18  
19 **48** suitability for implementation of HTR recommendations.  
20  
21  
22  
23  
24

25  
26 **50 Design:** Cross-sectional survey  
27  
28  
29

30 **51**  
31  
32 **52 Participants:** Purposeful sampling of international KT and HTR experts was administered  
33  
34 **53** between January and March 2019.  
35  
36  
37

38 **54**  
39  
40 **55 Methods:** Sixteen full-spectrum KT TMFs were rated by the experts as “yes”, “partially yes”, or  
41  
42 **56** “no” on six criteria: familiarity, logical consistency/plausibility, degree of specificity,  
43  
44 **57** accessibility, ease of use, and HTR suitability. Consensus was determined as a rating of  $\geq 70\%$   
45  
46 **58** responding “yes”. Descriptive statistics and manifest content analysis was conducted on open-  
47  
48 **59** ended comments.  
49  
50  
51

52  
53 **60**  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 61 **Results:** Eleven HTR and 11 KT experts from Canada, US, UK, Australia, Germany, Spain,  
4  
5 62 Italy and Sweden participated. Of the 16 KT TMFs, none received  $\geq 70\%$  rating. When ratings  
6  
7 63 of “yes” and “partially yes” were combined, the Consolidated Framework for Implementation  
8  
9 64 Research (CFIR) was considered the most suitable KT TMF by both KT and HTR experts  
10  
11 65 (86%). One additional KT TMF was selected by KT experts: Knowledge to Action framework.  
12  
13 66 HTR experts selected two additional KT TMFs: co-KT framework and Plan Do Study Act cycle.  
14  
15 67 Experts identified three key characteristics of a KT TMF that may be important to consider:  
16  
17 68 practicality, guidance on implementation, and KT TMF adaptability.  
18  
19  
20  
21  
22  
23

24 70 **Conclusions:** Despite not reaching an overall  $\geq 70\%$  rating on any of the KT TMFs, experts  
25  
26 71 identified four KT TMFs suitable for HTR. Users may apply these KT TMFs in the  
27  
28 72 implementation of HTR recommendations. In addition, KT TMFs characteristics relevant to the  
29  
30 73 field of HTR need to be explored further.  
31  
32  
33

34 74  
35  
36  
37 75 **Key words:** Health Technology Reassessment, Disinvestment, De-adoption, De-  
38  
39 76 implementation, Theories, Models and Frameworks, Knowledge Translation, Implementation  
40  
41 77 Science.  
42  
43  
44

45 78  
46  
47  
48 79  
49  
50  
51 80  
52  
53  
54 81  
55  
56  
57  
58  
59  
60

## 82 Article Summary

## 83 Strengths and Limitations of Study

- 84
- 85 • This was the first study to solicit the perspectives of international HTR and KT  
86 international experts on the suitability of KT TMFs for HTR.
  - 87 • Purposeful and snowball sampling was employed to obtain HTR and KT experts from  
88 different jurisdictions with a depth and breadth of knowledge in both KT and HTR to  
89 ensure a representative sample.
  - 90 • Through a survey, experts were asked to rate each KT TMF as “yes”, “partially yes”, or  
91 “no” on six criteria: familiarity, logical consistency/plausibility, degree of specificity,  
92 accessibility, ease of use, and HTR suitability to select potential KT TMFs for HTR.
  - 93 • Only full-spectrum KT TMFs (KT phases: planning/design, implementation, evaluation,  
94 and sustainability/scalability ) were included as these phases are critical to the KT  
95 process and necessary for the HTR process.
  - 96 • The sample size of HTR and KT experts was small which may have reduced the ability to  
97 generate consensus ( $\geq 70\%$  experts selected “yes”) for a suitable KT TMF for HTR.
- 98
- 99



1  
2  
3 100 **Background**  
4

5  
6 101

7  
8  
9 102 Health Technology Reassessment (HTR) is the systematic process of evaluating technologies  
10  
11 103 that are currently in the health system to ensure that they are being used optimally (1).  
12

13  
14 104 Recommendations from the HTR process can result in the increase use, decrease use, no change,  
15  
16 105 or complete withdrawal of the technology (2). However, implementation of these  
17  
18 106 recommendations has been challenging (2). It has been argued that the field of knowledge  
19  
20 107 translation (KT) could play a role in the implementation process for HTR recommendations (3).  
21

22  
23 108 KT has been described as “a dynamic and iterative process that includes the synthesis,  
24  
25 109 dissemination, exchange and ethically-sound application of knowledge to improve the health of  
26  
27 110 [populations], provide more effective health services and products, and strengthen the healthcare  
28  
29 111 system” (4). In essence, KT is the application of putting knowledge into practice and policy. KT  
30  
31 112 approaches could be used in the HTR process to bridge the gap between the generation of  
32  
33 113 recommendations regarding optimal technology use and their implementation in practice (3)  
34  
35 114 Thus, KT can be seen as complimentary to the HTR process, but there has been a paucity of  
36  
37 115 research in this area (3). Moreover, there is a gap in our understanding of which KT theories,  
38  
39 116 models, or frameworks (KT TMFs hereafter) would be best suited for the translation of HTR  
40  
41 117 recommendations (3).  
42  
43  
44

45  
46  
47 118

48  
49 119 In the literature, two narrative reviews and two scoping reviews have reported from 41 to 159  
50  
51 120 KT TMFs depending on how they are identified and considered (5-8). KT TMFs have been  
52  
53 121 used in different contexts, settings, and populations (5-8). Moreover, there has been some use of  
54  
55  
56  
57  
58  
59  
60

the KT interventions, strategies, and TMFs to decrease or remove low value care (9, 10). These KT TMFs have been used to help identify determinants, barriers and enablers to behaviour change related to HTR (11, 12). However, the use of these KT TMFs has not been applied consistently to the development of KT interventions or the field of HTR (3, 13). There are also no recommendations about which KT TMFs could be used for HTR. Through an international survey of KT and HTR experts, this study aims to provide an understanding of which KT TMFs could be appropriate for the HTR process and implementation of its recommendations.

## Methods

This study used three approaches to the selection of KT TMFs for HTR: identification of suitable KT TMFs, consensus on the list of KT TMFs through a modified Delphi process, and selection of potentially suitable KT TMFs through a survey of international KT and HTR experts.

Ethics approval was obtained from the University of Calgary's Conjoint Health Research Ethics Board [REB#17-0932].

## Identification of Suitable KT TMFs

Only full-spectrum KT TMFs were included. "Full-spectrum" includes all four KT phases: planning/design, implementation, evaluation, and sustainability/scalability (8). These four KT

phases are critical to the KT process and are thought to be necessary for the HTR process and implementation of its recommendations (3). A recent scoping review provided a preliminary list of 26 full-spectrum KT TMFs within cancer and chronic disease management contexts (8). A recent update of this scoping review conducted by the authors resulted in 36 full-spectrum KT TMFs identified (14). Eighteen were process models, eight were classic theories, three were determinant frameworks, three were evaluation frameworks, and four fit more than one approach category (14). This list of 36 full-spectrum KT TMFs provided the initial list of KT TMFs to assess for use when implementing HTR recommendations.

**Consensus on the list of KT TMFs using a Modified Delphi Process**

To ensure that the list of 36 full-spectrum KT TMFs was adequate and concise, a convenience sample consisting of the authors of this study reviewed this initial list to determine if any KT TMFs had been missed or could be eliminated based on HTR suitability. This sample was considered suitable as the authors had clinical training combined with expertise in KT or HTR and/or were experts at the doctorate level in these fields. A three-round modified Delphi process was undertaken (15-17). The Delphi process is iterative and used to determine expert group consensus where there is a lack of evidence and expert opinion is important (18). The first and second rounds involved independent review of each KT TMF to determine which would be suitable for HTR. Each author rated the KT TMF as “yes”, “potentially yes”, or “no” for HTR suitability. Consensus to keep the KT TMF was defined as 100% of the authors rating the KT TMF as “yes” and/or “potentially yes”. Consensus to eliminate the KT TMF was defined as

100% of the authors rating the KT TMF as “no”. Any KT TMFs that did not reach consensus were discussed in subsequent rounds. The third round entailed a two-hour face-to-face meeting held in October 2018. Prior to the discussion at this meeting, the authors agreed on ground rules, principles, and criteria for selection of KT TMFs for HTR suitability (Table 1). The authors deliberated on the remaining KT TMFs until consensus was reached. Verbal consent from the participants was obtained prior and the meeting was recorded.

## International Expert Survey

### *Selection of Experts to Review KT TMFs for HTR*

HTR and KT experts were selected through purposive and snowball sampling. Names were initially derived through the KT Canada website, Health Technology Assessment international (HTAi) Disinvestment Interest group, authors of relevant publications, and in consultation with other experts. A list of HTR and KT international experts was generated by country including Canada, US, UK, Australia, and European countries (Germany, Italy, Sweden, Spain). Experts were contacted via email to participate in the study. They were sent an email, invitation letter, and information sheet. If they agreed to participate, they were sent a consent form, a survey with the list of KT TMFs identified by the modified Delphi process to rate (Supplementary file 1), and recent article on the topic as background information (3). If they were unable to participate, the next expert name on the list was contacted. This was done to ensure that there were at least two HTR and two KT experts from each of Canada, US, UK, Australia (n=16) and four HTR and four KT experts from other European countries combined (n=8) for a target sample size of 24.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

187 Experts contacted could also suggest additional names of experts to be surveyed through  
188 snowball sampling. These names were added to the list of experts and contacted, if required, to  
189 reach a pre-defined number of participants. Representativeness was assessed by ensuring that  
190 experts came from different jurisdictions with a depth and breadth of knowledge in both KT and  
191 HTR.

192  
193 **Survey Development**

194  
195 The Enhancing The Quality and Transparency of Health Research (EQUATOR) good practice in  
196 the conduct and reporting of survey research guidelines were followed for the development of  
197 the survey (19). The survey included the list of KT TMFs, a description of each KT TMF,  
198 followed by a link to the paper that described the KT TMF, if one was available. Specific  
199 criteria used previously to select KT TMFs were used to rate each KT TMF (20). These  
200 included: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of  
201 use, and HTR suitability. Each criterion was operationally defined and reviewed by FC and  
202 HMM (Supplementary file 2). There was also a section for open-ended comments. The survey  
203 was developed in Excel and pilot tested by four participants to ensure flow and functionality.

## 208 Survey Administration

209

210 The survey was administered via email to the experts starting in January 2019. Based on the

211 criteria, each KT TMF was rated by each expert as “yes”, “partially yes” or “no” and additional

212 comments could be provided. Experts were also asked to suggest additional full-spectrum KT

213 TMFs that could be suitable for HTR and recommend other experts that could be contacted for

214 the study. Consensus was determined as  $\geq 70\%$  experts selected “yes” for the particular KT

215 TMF. The principles and criteria described in Table 1 were also shared with the international

216 experts for information purposes. Experts were asked to return the survey within two weeks.

217 Two additional reminders were sent. If surveys were not returned, then another expert on the list

218 was contacted to participate. The survey was sent out to experts until March 31, 2019 to ensure

219 that at least two HTR and two KT experts had agreed to complete the survey from the identified

220 countries.

## 222 Data Analysis

### 224 *Modified Delphi Process*

225 After rounds 1 and 2 of the modified Delphi process, data were analyzed descriptively by

226 tabulating the “yes”, “potentially yes”, and “no” responses for HTR suitability for each KT TMF

227 reviewed by the authors.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

*Survey Data*

Survey data were analyzed descriptively by tabulating the “yes”, “partially yes”, and “no” responses for HTR suitability for each KT TMF and by HTR and KT expert sub-groups. KT TMF familiarity and missing data were also descriptively summarized.

Data from the open-ended comments section of the survey provided by the HTR and KT experts were analyzed using content analysis (21). As these data were limited in volume, content analysis was undertaken to provide a starting point in determining preliminary factors that may be important to consider for a KT TMF for HTR.

Initially, all comments from each expert were entered into Excel and categorized by KT TMF. These were read and reread to get familiarized with the data. Next, for each KT TMF, each comment was organized by response to HTR suitability as “yes”, “partially yes”, “no”, and unfamiliar with the KT TMF. This categorization provided an understanding of what comments may or may not be important to consider for HTR suitability. Open coding and constant comparison were applied inductively to all the comments. A preliminary list of codes, sub-codes, and operational definitions were developed manually through independent review of the comments from three KT TMFs (Consolidated Framework for Implementation Research (CFIR), Stages of Research Evaluation, and Knowledge to Action (KTA) framework) by RE and HMM. A final taxonomy consisting of codes, sub-codes, and operational definitions with exemplar quotes was applied manually to the comments for the remaining KT TMFs by RE (Box 1). Manifest content analysis, defined as the development of categories as opposed to latent content analysis (defined as the development of themes), was determined to be best suited given the

253 nature of the open-ended comments (21). Categories were created, grouping codes under higher  
254 order headings, and formulating a general description of these categories. In addition, the  
255 frequency of comments for each code in each category was also tabulated by HTR and KT expert  
256 to determine the top categories/codes. The most prominent codes and interpretation of the data  
257 were determined through frequency counts, discussion, and consensus among FC and HMH.

258

### 259 **Patient and public involvement**

260

261 Patients or the public were not involved in the design, or conduct, or reporting, or dissemination  
262 plans of our research.

263

### 264 **Results**

265

### 266 **Modified Delphi Process**

267

268 The results of the modified Delphi process are presented in Table 2. The third round resulted in  
269 the selection of 16 full-spectrum KT TMFs. There were 12 process models, two frameworks, one  
270 classic theory, and one KT TMF that fit two categories (model and framework). Twenty KT  
271 TMFs were excluded. Fourteen were too vague and not descriptive enough, two were considered  
272 ‘passive’ and not ‘active’ KT TMFs to make change happen, two were not pragmatic, and two  
273 were too specific to a given context (i.e. guideline adaptation and disability research)  
274 (Supplementary file 3).



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**International Expert Survey**

Forty-eight KT experts and 31 HTR experts were invited to participate via email. A total of 22 experts (11 KT and 11 HTR) completed the survey. Experts were from Canada (4), US (5), UK (3), Australia (4), Germany (2), Spain (1), Italy (1), and Sweden (2). Fifty-nine percent were women, and all had graduate-level education (Masters or PhD).

Overall, of the 16 KT TMFs none received a “yes” rating for HTR suitability by  $\geq 70\%$  of the experts. The top three most highly rated KT TMFs were CFIR (22), KTA (23) and the Plan-Do-Study-Act (PDSA) cycle (24). Thirty-eight percent of the experts rated CFIR as “yes”, followed by 27% each for the KTA framework and the PDSA cycle (24). The least rated KT TMFs by the experts were the KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (25), the Stages of Research Evaluation (26), the Staged Model of Innovation Development and Diffusion of Health Promotion Programs (27) which all received 0% ratings for “yes” by the experts (Figure 1). Combination of the “yes” or ‘partially yes’ ratings found that 86% (19/22) of the experts selected CFIR as the top rated KT TMF for HTR suitability (22).

**Stratified analysis by KT and HTR Expertise**

KT experts favored KTA (82%, 9/11) as another KT TMF that would be suitable for HTR (23) in addition to CFIR (91%, 10/11). HTR experts favored the Co-KT Framework (72%, 8/11) (28) and the PDSA cycle, (72%, 8/11) (24) in addition to CFIR (82%, 9/11).

## 298 Content Analysis

299

300 Forty-nine percent of the comments provided by both KT and HTR experts were related to the  
301 TMF characteristics category, followed by the TMF attributes category (19%). Implementation  
302 and user categories both had 13% each (Figure 2).

303

304 Overall, the top code was “pragmatic” under the TMF characteristics category (14%) defined as  
305 the KT TMF not being theoretical but practical and application of the TMF outside of research or  
306 academic settings. This was followed by implementation (13%), defined as the KT TMF  
307 provides operation detail on how to ‘do’ the implementation to achieve the HTR outputs. This  
308 included exploring determinants, their inter-relationships, and the development of interventions  
309 or strategies based on these determinants. The third top code was HTR suitability under the TMF  
310 attributes category (8%), defined as a ‘strong fit’ to HTR and its determinants. It also included  
311 the ability to adapt the KT TMF and tailor it to micro (individual), meso (organizational), and  
312 macro (policy) levels (3).

313

314 More KT experts than HTR experts commented on pragmatic as an important characteristic for a  
315 KT TMF (56% versus 44%). There were both positive and negative comments related to  
316 pragmatic for a KT TMF that would make it suitable for HTR. For example, one KT expert who  
317 said “yes” to HTR suitability for the PDSA cycle noted the following positive affect:

318

319 “A basic, simple but still very useful approach” [009].

1  
2  
3 320 In contrast, in reference to the Stages of Research Evaluation, one HTR expert who said ‘no’ to  
4  
5 321 HTR suitability stated the following negative affect:  
6  
7  
8 322  
9  
10 323 “This is also difficult to be implemented in reality as it is far from explaining the  
11  
12 324 characteristics of the healthcare systems and professional interactions” [017].  
13  
14  
15 325  
16  
17 326 More KT experts than HTR experts provided comments related to implementation (78% versus  
18  
19 327 22%). There were both positive and negative affects of comments related to implementation for a  
20  
21 328 KT TMF that would make it suitable for HTR. One KT expert who said “yes” to HTR suitability  
22  
23 329 for the Quality Implementation framework stated the following positive affect:  
24  
25  
26 330  
27  
28 331 “I’m not familiar with specifics about this framework; it certainly covers the full-  
29  
30 332 spectrum of considerations for implementing new interventions; could be adapted for de-  
31  
32 333 adoption/implementation “[005].  
33  
34  
35 334  
36  
37 335 On the contrary, another KT expert who said ‘no’ to HTR suitability with respect to Diffusion of  
38  
39 336 Innovation theory stated the following negative affect:  
40  
41  
42 337  
43  
44 338 “I think (as it is a general theory rather than an implementation framework/model) that it  
45  
46 339 lacks sufficient guidance on how to implement/de-implement” [007].  
47  
48  
49 340  
50  
51 341 More KT experts provided comments to HTR suitability than HTR experts (60% versus 40%).  
52  
53 342 There were both positive and negative affects of comments related to HTR suitability for a KT  
54  
55  
56  
57  
58  
59  
60

343 TMF. One HTR expert who said partially “yes” to HTR suitability for CFIR stated the following  
344 positive affect:

345  
346 “A lot of constructs have been included in CFIR, so in each case, it would probably  
347 require selection of the specific ones relevant for the HTR example” [021].

348  
349 Whereas another KT expert who said ‘no’ to HTR suitability for the CollaboraKTion framework  
350 stated:

351  
352 “Depends on focus of work-this emphasizes need for community to decide on action  
353 whereas if you had a particular output in mind to implement/de-implement this might not  
354 be the best fit” [001].

355  
356 However, HTR experts commented more on the ability to tailor the KT TMF to micro, meso,  
357 macro levels than KT experts (90% versus 10%).

## 358 359 **Discussion**

## 360 361 **Key Findings**

362  
363 The focus of this study was to determine KT TMFs that could be suitable for implementation of  
364 HTR recommendations. Three key findings emerged: 1)  $\geq 70\%$  consensus (rated as “yes” by  
365 the experts) was not reached by the international KT and HTR experts on any of the current full-

1  
2  
3 366 spectrum KT TMFs; however when ratings of “yes” and “partially yes” were combined, CFIR  
4  
5 367 was considered the most suitable KT TMF by both KT and HTR experts; 2) KT experts  
6  
7 368 identified one additional KT TMF: KTA framework, whereas HTR experts identified two  
8  
9 369 additional KT TMFs: co-KT framework and PDSA cycle as potentially suitable for HTR ; and 3)  
10  
11 370 Overall, experts commented on three key characteristics of a KT TMF that may be important to  
12  
13 371 consider: practicality, guidance on how to implement, and adaptability of the KT TMF to HTR.  
14  
15 372

16  
17  
18  
19 373 **Strengths**  
20  
21 374

22  
23 375 This study utilized a modified Delphi process and survey to illicit input from study authors and  
24  
25 376 international KT and HTR experts. Although, experts may not have sufficient knowledge of all  
26  
27 377 the KT TMFs, this was the first study that attempted to garner the opinions of experts in both  
28  
29 378 fields. The field of KT and its application to HTR has been proposed as a mechanism to  
30  
31 379 advance the implementation of HTR recommendations into practice (3). The selection of one  
32  
33 380 determinant framework (CFIR), and three process models (KTA framework, co-KT framework,  
34  
35 381 and the PDSA cycle) provides a starting point of potential KT TMFs that could be used with  
36  
37 382 HTR. However, as  $\geq 70\%$  consensus was not reached by the experts, these findings need to be  
38  
39 383 considered as preliminary.  
40  
41 384

42  
43  
44  
45 385 **Limitations**  
46  
47 386

48  
49 387 The Delphi technique has been criticized for lack of guidelines on the determination of the size  
50  
51 388 of the expert panel, lack of anonymity, what is meant by ‘expert’ opinion, and determination on  
52  
53  
54  
55  
56  
57  
58  
59  
60

the level of consensus (29). The sample size of five may have been too small to select KT TMFs from the list of 36 full-spectrum KT TMFs. The 100% consensus level may have been too high. There may also have been pressures of conformity at the face-to-face meeting. However, the authors had a wide-range of expertise in HTR, KT or both. The use of a facilitator and establishment of ground rules, and principles upfront were important considerations to address pressures of conformity.

Although purposeful sampling was used for the survey, the sample size of international KT and HTR experts was small which may have reduced the ability to generate consensus. However, considerable efforts were made to target experts with knowledge and practical experience in KT and/or HTR. Lastly, the selection of 70% consensus was arbitrary and determined a priori to survey administration. This level of agreement has been considered appropriate in previous Delphi studies (30), but there is no acceptable level of consensus (29).

### **Implications of Findings**

Among the list of 16 full-spectrum KT TMFs identified through a modified Delphi process, the international experts were not able to select a current KT TMF for HTR. Lack of familiarity with the KT TMFs could be one reason. Specifically, experts were not familiar enough with four of the 16 KT TMFs to rate them for HTR suitability. Over recent years, there has been a flurry of KT TMFs developed (8). This proliferation of KT TMFs makes it challenging for experts to keep abreast of them. Moreover, there has been criticism of the development of KT TMFs

1  
2  
3 411 without adequate testing, validation and research (31). Experts within the KT field may lean  
4  
5 412 towards those KT TMFs that they are most familiar with (8).  
6  
7 413  
8  
9  
10 414 Another reason experts were challenged to select a KT TMF may be the lack of understanding of  
11  
12 415 the HTR process. KT experts in particular, may have found it difficult to review the KT TMFs  
13  
14 416 and then apply them to HTR, as they may not be familiar enough with the HTR process itself.  
15  
16 417 HTR has also been confused with terms such as ‘disinvestment’ and ‘de-adoption’, which are  
17  
18 418 considered outcomes of the HTR process rather than the process itself (2). In addition, the field  
19  
20 419 of HTR is under-developed and concepts have yet to be agreed upon (3). An information sheet  
21  
22 420 and background paper with a description of the fields of KT and HTR was provided to the  
23  
24 421 experts prior to the survey. However, these materials may not have been reviewed in advance or  
25  
26 422 been a sufficient knowledge resource.  
27  
28  
29  
30  
31 423  
32  
33 424 CFIR was the only KT TMF selected by both HTR and KT experts as a potential KT TMF that  
34  
35 425 could be used for HTR. CFIR has been used widely and is a well-operationalized, multi-level  
36  
37 426 implementation determinant framework derived from theory (32, 33). The application of CFIR  
38  
39 427 and its constructs may enable users to assess facilitators and barriers to the implementation of  
40  
41 428 HTR recommendations, particularly when HTR recommendations result in decreased use or  
42  
43 429 removal of the technology. The assessment of facilitators and barriers has been noted as an  
44  
45 430 important step within the de-adoption process of low value care (3, 34). However, future  
46  
47 431 research with a focus on the application of CFIR to HTR projects is needed.  
48  
49  
50  
51 432  
52  
53  
54  
55  
56  
57  
58  
59  
60

The KTA framework was primarily selected as suitable for HTR by KT experts. Its selection could be due to its wide-spread use in the KT field (35, 36). In fact, one adaptation of the KTA framework has been the Synthesis Framework for Facilitating De-adoption (34). This framework has been proposed for potential use in HTR projects (3). However, it has yet to be applied in practice. Nonetheless, the KTA framework's ability to be adaptable may be another factor in its selection primarily by KT experts.

The co-KT framework (28) and PDSA cycle (24) were primarily selected for HTR suitability by HTR experts. Both are process models (14). The co-KT framework is a linear process and may be considered simplistic to apply. The PDSA cycle has been used extensively in quality improvement as a model for change (37). It is a simple and pragmatic model to use and is adaptable within other models (38). However, it is not without its limitations (37). Subsequently, selection of these KT TMFs by HTR experts may be due their ease of use.

### **Implications for Future Research**

Although not the key focus of this study, three key characteristics: practicality, guidance on how to implement; and adaptability of the KT TMF to HTR were identified from the open-ended comments. These key characteristics and others maybe important to further interrogate. , Future research on identifying the key elements, attributes, constructs of KT TMFs for HTR through expert interviews is needed to better understand which would influence and demonstrate an important role for HTR.



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

456 Recently, there has also been a proliferation of disinvestment frameworks or frameworks to  
457 address overuse (13, 39, 40). Some are based on KT and Implementation Science principles  
458 (13). The focus of these frameworks has been on removing or reducing low value care from  
459 practice. The application of these frameworks is still in its infancy. Although, the list of full-  
460 spectrum KT TMFs that were examined in this study did not consider these disinvestment  
461 frameworks, there may be merit in doing so.

462  
463 **Conclusion**

464  
465 This study provided insights into which KT TMFs may be suitable for HTR. Despite not  
466 attaining  $\geq 70\%$  rated as “yes” on any of the KT TMFs through the survey, experts identified  
467 four KT TMFs that could potentially be used within the context of HTR (CFIR, KTA, co-KT,  
468 and PDSA). Familiarity, adaptability and ease of use may be some of the reasons that led to their  
469 selection. Moreover, characteristics of practicality, how to implement HTR recommendations,  
470 and adaptability of the KT TMF to HTR need to be interrogated to determine if they are  
471 important in a KT TMF for HTR. The process of HTR could benefit from the field of KT and  
472 its application of KT TMFs in implementation of its recommendations. Future research on the  
473 application of KT TMFs to HTR projects will provide much needed guidance and advancement  
474 in this area.

476 **Competing Interests:** None.

477

478 **Funding:** Rosmin Esmail is funded through an Alberta Innovates – Health Solutions Graduate  
479 Studentship Award. The funding body did not participate in the design of the study and  
480 collection, analysis, and interpretation of data or writing of the manuscript.

481 **Award/grand number-**Not Applicable

482

483 **Data Availability:** All data relevant to the study are included in the article or uploaded as  
484 supplementary information.

485

486 **Contributors:** Rosmin Esmail conducted the study, collected, analyzed, and interpreted the data.  
487 Rosmin Esmail, Fiona Clement and Heather Hanson drafted the manuscript. Rosmin Esmail,  
488 Fiona Clement, Heather Hanson, Jayna Holroyd-Leduc and Daniel J Niven contributed to the  
489 study conception and design, planning, data interpretation, and were involved in revising the  
490 manuscript for important intellectual content. Rosmin Esmail, Fiona Clement, Heather Hanson,  
491 Jayna Holroyd-Leduc and Daniel J Niven read, provided edits, and approved the final  
492 manuscript.

493

494 **Acknowledgments:** We would like to thank all the individuals that participated in this study for  
495 their support and contributions to this work.

496

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Ethics Statement:** Ethics approval was obtained from the University of Calgary’s Conjoint Health Research Ethics Board [REB#17-0932]. Participants were provided with a background study information sheet and provided written informed consent before taking part in the study.

For peer review only

## References:

1. Noseworthy T, Clement FM. Health Technology Reassessment: Scope, Methodology, & Language. *Int J Technol Assess Health Care*. 2012;28(3):201-2.
2. Soril L, MacKean G, Noseworthy TM, Leggett LE, Clement FM. Achieving Optimal Technology Use: A proposed model for health technology reassessment. *Sage Open Medicine*. 2017;5:1-7.
3. Esmail R, Hanson H, Holyrood-Leduc J, Niven DJ, Clement F. Knowledge translation and health technology reassessment: identifying synergy. *BMC Health Serv Res*. 2018;18:674.
4. Canadian Institutes of Health Research. Knowledge Translation. 2017 [Available from: <http://www.cihr-irsc.gc.ca/e/29529.html>].
5. Lokker C, McKibbon KA, Colquhoun H, Hempel S. A scoping review of classification schemes of interventions to promote and integrate evidence into practice in healthcare. *Implement Sci*. 2015;10:27.
6. Milat AJ, Li B. Narrative review of frameworks for translating research evidence into policy and practice. *Public Health Res Pract*. 2017;27(1):1-13.
7. Tabak RG, Khoong EC, Chambers DA, Brownson RC. Bridging research and practice: models for dissemination and implementation research. *Am J Prev Med*. 2012;43(3):337-50.
8. Striffler L, Cardoso R, McGowan J, Cogo E, Nincic V, Khan PA, et al. Scoping review identifies number of knowledge translation theories, models and frameworks with limited use. *Journal of Clinical Epidemiology*. 2018;100:92-102.
9. Colla CH, Mainor AJ, Hargreaves C, Sequist T, Morden N. Interventions Aimed at Reducing Use of Low-Value Health Services: A Systematic Review. *Medical Care Research and Review*. 2017;74(5):507-50.
10. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci*. 2012;7(1):37.
11. French SD, Green SE, O'Connor DA, McKenzie JE, Francis JJ, Michie S, et al. Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implement Sci*. 2012;7(1):38.
12. Soril LJJ, Noseworthy TW, Stelfox HT, Zygun DA, Clement FM. Facilitators of and barriers to adopting a restrictive red blood cell transfusion practice: a population-based cross-sectional survey. *CMAJ open*. 2019;7(2):E252-E7.
13. Grimshaw JM, Patey AM, Kirkham KR, Hall A, Dowling SK, Rodondi N, et al. De-implementing wisely: developing the evidence base to reduce low-value care. *BMJ Qual Saf*. 2020:bmjqs-2019-010060.
14. Esmail R, Hanson HM, Holroyd-Leduc J, Brown S, Striffler L, Straus SE, et al. A scoping review of full-spectrum knowledge translation theories, models, and frameworks. *Implement Sci*. 2020;15(1):11.
15. Dalkey NC. The Delphi Method: An experimental study of group opinion. RM-58888-PR TRCP, editor. Santa Monica. 1969.
16. Dalkey NC, Helmer O. An experimental application of the Delphi method to the use of experts. *Manag Sci* 1963;9(3):458-67.
17. Hsu CC, Sanford BA. The Delphi Technique: Making Sense Of Consensus. *Practical Assessment Research & Evaluation*. 2007;12(10):2-8.

1  
2  
3 547 18. Meshkat B, Cowman S, Gethin G, Ryan K, Wiley M, Brick A, et al. Using an e-Delphi  
4 548 technique in achieving consensus across disciplines for developing best practice in day surgery  
5 549 in Ireland. *J Hosp Adm.* 2014;3(4):1-8.  
6 550 19. Kelley K, Clark B, Brown V, Sitzia J. Good practice in the conduct and reporting of  
7 551 survey research. *Int J Qual Health Care.* 2003;15(3):261-6.  
8 552 20. Birken SA, Powell BJ, Shea CM, Haines ER, Kirk MA, Leeman J, et al. Criteria for  
9 553 selecting implementation science theories and frameworks: results from an international survey.  
10 554 *Implement Sci.* 2017;12:124.  
11 555 21. Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis:  
12 556 Implications for conducting a qualitative descriptive study. *Nurs Health Sci.* 2013;15(3):398-  
13 557 405.  
14 558 22. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering  
15 559 implementation of health services research findings into practice: a consolidated framework for  
16 560 advancing implementation science. *Implement Sci.* 2009;4(1):50.  
17 561 23. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, et al. Lost in  
18 562 knowledge translation: time for a map? *J Contin Educ Health Prof.* 2006;26(1):13-24.  
19 563 24. Deming W. Plan-Do-Study-Act (PDSA) Cycles 1986 [Available from:  
20 564 <https://deming.org/explore/p-d-s-a>]  
21 565 25. Nieva VF MR, Ridley N, et al. From Science to Service: A Framework for the Transfer  
22 566 of Patient Safety Research into Practice. . United States: In: Henriksen K, Battles JB, Marks ES,  
23 567 et al., editors. *Advances in Patient Safety: From Research to Implementation (Volume 2:  
24 568 Concepts and Methodology)*. Rockville (MD): Agency for Healthcare Research and Quality  
25 569 2005 Feb.  
26 570 26. Nutbeam D, Bauman AE. *Evaluation in a Nutshell: A Practical Guide to the Evaluation  
27 571 of Health Promotion Programs*: McGraw-Hill; 2006.  
28 572 27. Oldenburg BF, Hardacker C, Ffrench ML. How does Research Contribute to Evidence-  
29 573 based Practice in Health Promotion? *Health Promot J Aust.* 1996;6(2):15-20.  
30 574 28. Kitson A, Powell K, Hoon E, Newbury J, Wilson A, Beilby J. Knowledge translation  
31 575 within a population health study: how do you do it? *Implement Sci.* 2013;8(1):54.  
32 576 29. The Delphi Technique. *The Delphi Technique in Nursing and Health Research.* p. 1-17.  
33 577 30. Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, et al. Defining  
34 578 consensus: A systematic review recommends methodologic criteria for reporting of Delphi  
35 579 studies. *Journal of Clinical Epidemiology.* 2014;67(4):401-9.  
36 580 31. Wensing M, Grol R. Knowledge translation in health: how implementation science could  
37 581 contribute more. *BMC Medicine.* 2019;17(1):88.  
38 582 32. Birken SA, Powell BJ, Presseau J, Kirk MA, Lorencatto F, Gould NJ, et al. Combined  
39 583 use of the Consolidated Framework for Implementation Research (CFIR) and the Theoretical  
40 584 Domains Framework (TDF): a systematic review. *Implementation science : IS.* 2017;12(1):2.  
41 585 33. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic  
42 586 review of the use of the Consolidated Framework for Implementation Research. *Implementation  
43 587 science : IS.* 2016;11:72-.  
44 588 34. Niven DJ, Mrklas KJ, Holodinsky JK, Straus SE, Hemmelgarn BR, Jeffs LP, et al.  
45 589 Towards understanding the de-adoption of low-value clinical practices: a scoping review. *BMC  
46 590 Medicine.* 2015;13(1):255.  
47 591 35. Field B, Booth A, Illott I, Gerrish K. Using the Knowledge to Action Framework in  
48 592 practice: a citation analysis and systematic review. *Implement Sci.* 2014;9(1):172.

36. Esmail R, Hanson H, Holroyd-Leduc J, Brown S, Strifler L, Straus S, et al. A Scoping Review of Full-Spectrum Knowledge Translation Theories, Models and Frameworks - draft manuscript. 2020.
37. Reed JE, Card AJ. The problem with Plan-Do-Study-Act cycles. *BMJ Quality & Safety*. 2016;25(3):147-52.
38. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Quality & Safety*. 2014;23(4):290.
39. Norton WE, Chambers DA, Kramer BS. Conceptualizing De-Implementation in Cancer Care Delivery. *Journal of Clinical Oncology*. 2019;37(2):93-6.
40. Parchman ML, Henrikson NB, Blasi PR, Buist DS, Penfold R, Austin B, et al. Taking action on overuse: Creating the culture for change. *Healthc (Amst)*. 2017;5(4):199-203.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

607     **Table 1: List of Criteria Developed by Authors for Round 3 of Modified Delphi Process**

Criteria
The KT TMFs must have face validity (KT TMFs that are common and well-known should be included)
The KT TMFs must be active KT TMFs (passive KT TMFs were excluded)
The KT TMF must be feasible to apply to take something out of practice
The KT TMF was pragmatic (theoretical KT TMFs were excluded)
The KT TMF must be specific (vague or those that were not prescriptive were excluded)
The KT TMF could build on other KT TMFs but needed to be generic rather than for a specific context
The KT TMF is easily understood and practical
Any KT TMF that the committee was undecided on

608

**Box 1: Taxonomy of Codes and Sub-codes for Comments Provided in the Survey**

Implementation	TMF Characteristics	TMF Attributes	User	Survey Logistics/General Comments
Codes in a KT TMF related to implementation of HTR	Codes related to elements or components in a KT TMF for HTR	Codes that are considered foundational in a KT TMF for to HTR	Codes related to the use of TMFs for HTR from a user perspective	Codes related to the process of survey administration or extraneous
<ul style="list-style-type: none"> <li>Implementation               <ul style="list-style-type: none"> <li>Development of intervention or strategies</li> <li>Inter-related determinants</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Pragmatic real world application</li> <li>Straightforward</li> <li>Engagement of relevant (patient, public, clinician) stakeholders               <ul style="list-style-type: none"> <li>Synchronicity</li> </ul> </li> <li>Lack specificity/insufficient details</li> <li>Complexity</li> <li>Prioritization of HTR</li> <li>Resources such as economic, evidence, funding, local factors.               <ul style="list-style-type: none"> <li>Additional support</li> </ul> </li> <li>Adaptation               <ul style="list-style-type: none"> <li>Additional TMFs</li> </ul> </li> <li>Sustainability</li> <li>Evaluation</li> <li>Influential               <ul style="list-style-type: none"> <li>Originality (face validity)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>HTR Suitability</li> <li>Consideration of alternatives</li> <li>Ability to tailor or applicability micro/meso/macro levels</li> <li>Centrality evidence</li> <li>Contextual fit</li> <li>Motivation               <ul style="list-style-type: none"> <li>Challenge of removing something (feasible to apply -take something out of practice)</li> </ul> </li> <li>Values</li> <li>Generalizability</li> <li>Not a KT TMF</li> </ul>	<ul style="list-style-type: none"> <li>Familiarity</li> <li>Access</li> <li>Use by novices</li> </ul>	<ul style="list-style-type: none"> <li>Survey process/method oriented</li> <li>Non-dated data</li> </ul>



**Table 2: Summary Results of KT Theories, Models and Frameworks Included and Excluded from Rounds 1 to 3 of the Modified Delphi Process**

Included in Round 1	Excluded in Round 1
Consolidated Framework for Implementation Research (CFIR) (Damschroder, 2009)	A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)
Stages of research evaluation (Nutbeam, 2006)	Interorganizational Relations Theory (Steckler, 2002)
Knowledge-to-Action (KTA) (Graham, 2006)	Self-Regulation Theory (Baumeister, 2011)
Quality Implementation Framework (Meyers, 2012)	Social Cognitive Theory (SCT) (Bandura, 1991)
Western Australia (WA) Health Network Policy Development and Implementation Cycle (Briggs, 2012)	Social Ecology Model for Health Promotion (Stokols, 1992)
	Transtheoretical Model of Behaviour Change (Prochaska, 1997)
Included in Round 2	Excluded in Round 2
Collaborative model for achieving breakthrough improvement (Institute for Healthcare Improvement, 2003)	LEAN transformation process (Lean Enterprise, 2011)
Included in Round 3	Excluded in Round 3
Diffusion of Innovations (Rogers, 1983)	NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)
Healthcare Improvement Collaborative Model (Edward, 2017)	Community Connection model (Liddy, 2013)
Co-KT framework (Kitson, 2013)	Model for accelerating improvement (Associates in Process Improvement Langley, 2009)
Plan-do-study-act cycle (Deming, 1986)	Social marketing framework (National Excellence Collaborative, 2003)
A staged model of innovation development and diffusion of health promotion programs (Oldenburg, 1996)	Community-based Knowledge Translation framework (Campbell, 2010)
Evidence-driven community health improvement process (EDCHIP) (Layde, 2012)	Knowledge integration process (Glasgow, 2012)
RE-AIM (Glasgow, 1999)	Precaution Adoption Process model (Weinstein, 2008)
CollaboraKTion framework (Jenkins, 2016)	Social learning theory (Bandura, 1952)
KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (Nieva, 2005)	CAN-IMPLEMENT (Harrison, 2018)

Design focused implementation model (Ramaswamy, 2018)	The translational model of the Black Dog Institute (Werner-Seidler, 2016)
	PRECEDE-PROCEED (Green, 2005)
	Community to community mentoring model (Liddy, 2013)
	Stage theory of organizational change (Butterfoss, 2008)
<b>Total Included=16</b>	<b>Total Excluded=20</b>

For peer review only

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Figure legend**

Figure 1: HTR Suitability of KT Theories, Models, Frameworks (TMFs) by all Experts

Figure 2: Total Comments for Each Category Provided by KT and HTR Experts

For peer review only

**Figure 1: HTR Suitability of KT Theories, Models, Frameworks (TMFs) by all Experts**

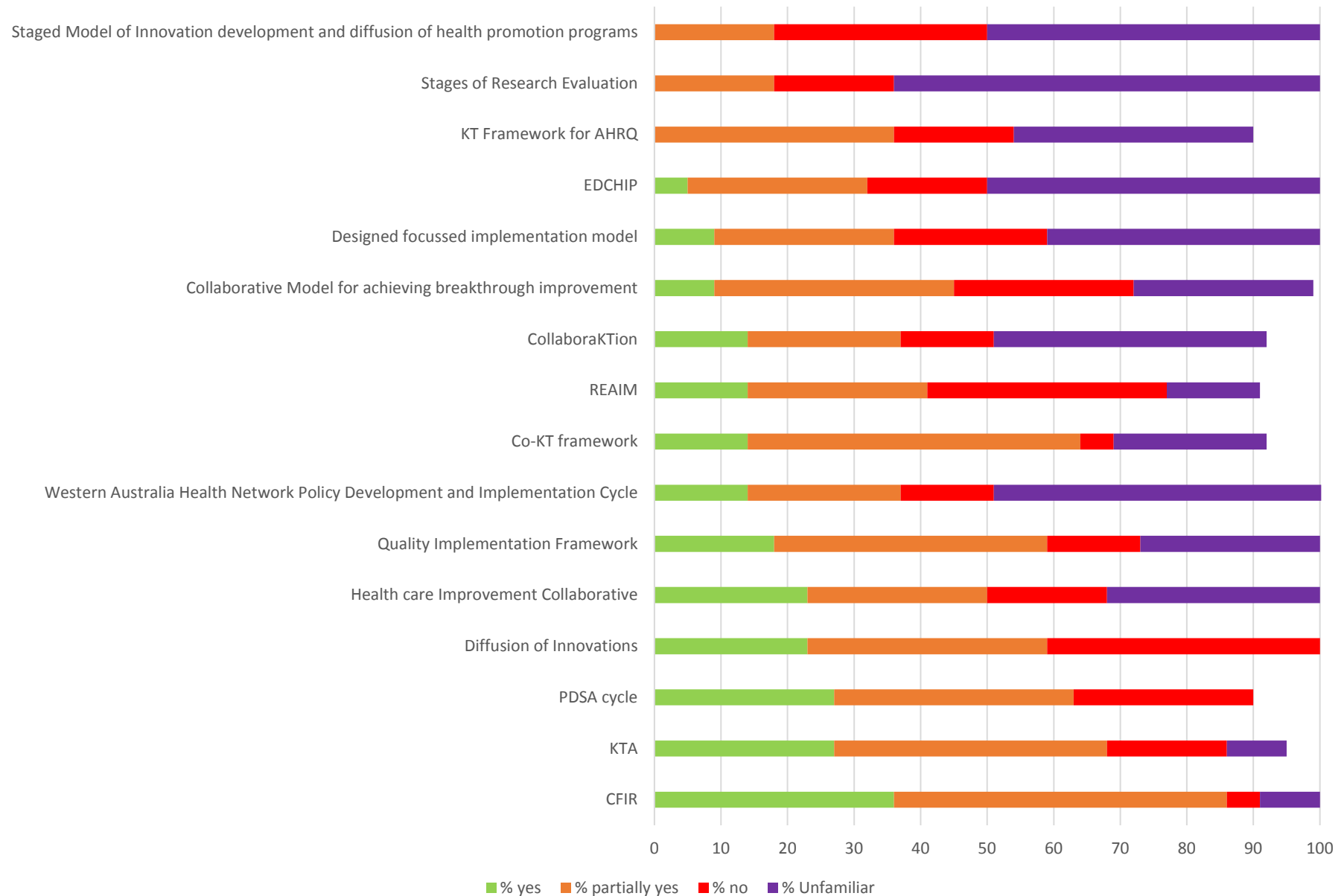
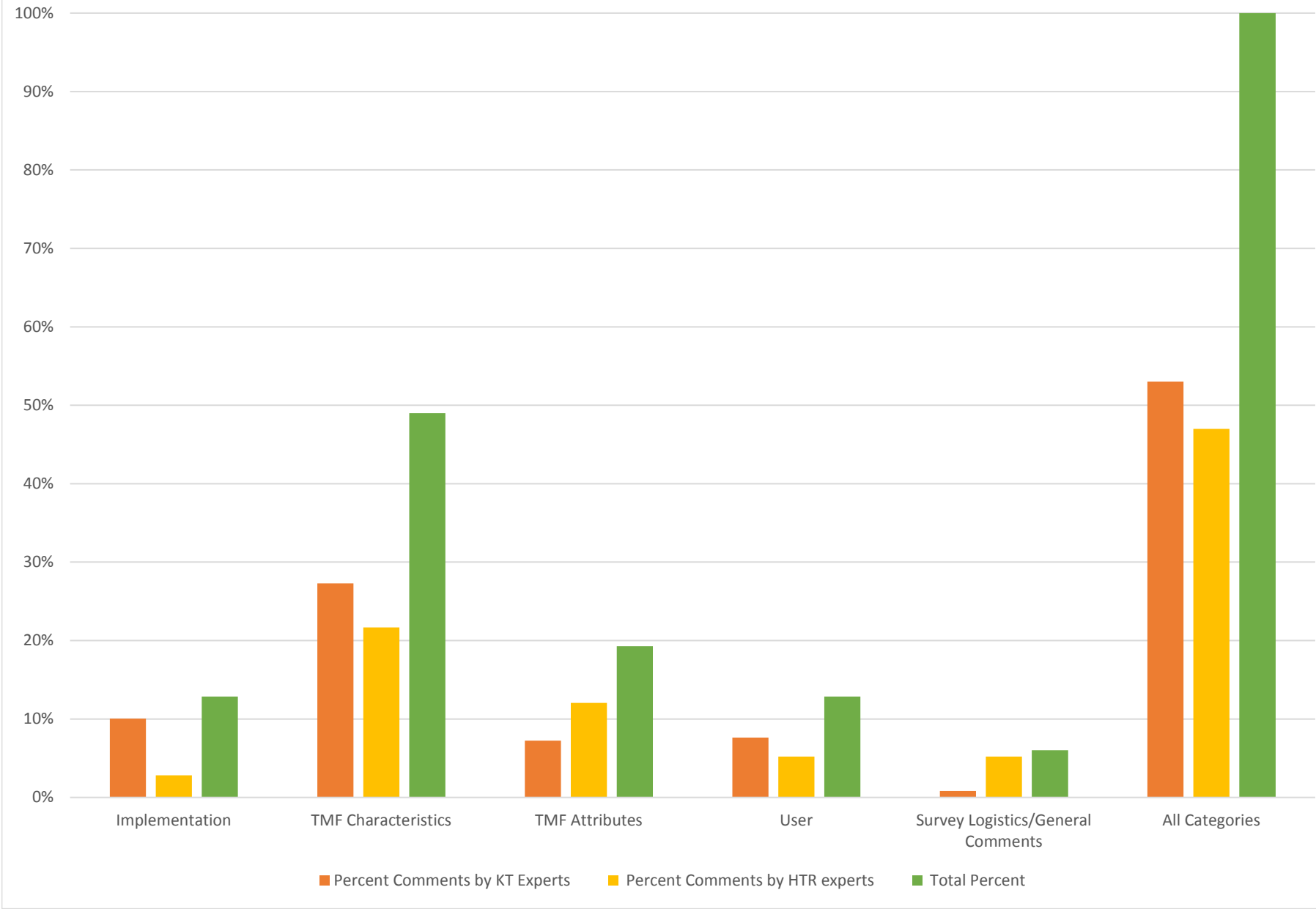


Figure 2: Total Comments for Each Category Provided by KT and HTR Experts



**Instructions:**

Dear Expert, there are 16 full-spectrum KT theories, models and frameworks to review in column A. A brief description of each KT theory, model, framework is provided through a comment box (red triangle in corner of the cell) and a link to the paper, if available, in column B. For each full-spectrum Knowledge Translation (KT ) theory, model or framework please review each criteria in sheet #1 columns C to G and rate as yes, partially yes, or no using the drop box menu.

In sheet #1, based on your responses to columns C to G, please determine if that KT theory, model or framework is suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology) and indicate your response as yes, partially yes, or no using the drop box menu in column H.

In sheet #1, column I, please feel free to provide any comments.

Please feel free to respond to questions in rows #18 and #19.

Please save your file and return it via email to [rosmin.esmail@ucalgary.ca](mailto:rosmin.esmail@ucalgary.ca)

**Definitions:**

**Knowledge Translation (KT):** a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products, and strengthen the healthcare system (CIHR, 2017)

**Health Technology Reassessment (HTR):** is a structured, evidence-based assessment of the clinical, social, ethical, and economic effects of a technology currently in use to inform its optimal use in comparison to its alternatives (Noseworthy and Clement, 2012)

**Full-Spectrum:** A full-spectrum KT theory, model or framework is one that that has been used in the literature by study authors to inform their KT work and guide all four KT phases: i) planning/design (identifies a knowledge gap, engages stakeholders, develops an intervention), ii) implementation, iii) evaluation, and iv) sustainability/scalability (Strifler et al, 2018)



## Supplementary file 2: Operational Definition of Criteria

Criteria	Operational Definition
<b>Familiarity</b>	Are you familiar with the KT, theory, model or framework?
<b>Logical Consistency/Plausibility</b>	Does the KT theory, model or framework, include meaningful, face-valid explanations of proposed relationships?
<b>Degree of specificity</b>	Does the KT theory, model, or framework include constructs that are comprehensive of implementation determinants or specific to a set of implementation determinants that could be applied to health technology reassessment (HTR)?
<b>Accessibility</b>	Would non-experts be able to understand, apply and operationalize the KT theory, model, or framework to HTR?
<b>Ease of use</b>	Can the KT theory, model, or framework be used easily?
<b>HTR Suitability</b>	Based on your responses to the previous criteria, is the KT theory, model, framework suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology)?



**Supplementary file 3: List of Excluded KT Theories, Models, and Frameworks and Reason of Exclusion from the Modified Delphi Process (n=20)**

KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)	X			
Interorganizational Relations Theory (Steckler, 2002)	X			
Self-Regulation Theory (Baumeister, 2011)		X		
Social Cognitive Theory (SCT) (Bandura, 1991)			X	
Social Ecology Model for Health Promotion (Stokols, 1992)	X			
Transtheoretical Model of Behaviour Change (Prochaska, 1997)			X	
LEAN transformation process (Lean Enterprise, 2011)		X		
NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)				X
Community Connection model (Liddy, 2013)	X			
Model for accelerating improvement (Associates in Process Improvement Langley, 2009)	X			
Social marketing framework (National Excellence Collaborative, 2003)	X			
Community based KT framework (Campbell, 2010)	X			
Knowledge integration process (Glasgow, 2012)	X			
Precaution Adoption Process model (Weinstein, 2008)	X			
Social learning theory (Bandura, 1952)	X			
CAN-IMPLEMENT (Harrison, 2018)				X (guideline focused)
The translational model of the Black Dog Institute (Werner-Seidler, 2016)	X			
PRECEDE-PROCEED (Green, 2005)	X			

KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
Community to community mentoring model (Liddy, 2013)	X			
Stage theory of organization change (Butterfoss, 2008)	X			

For peer review only